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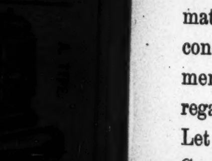

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THE TELEGRAPHIC JOURNAL AND

Electrical Review.

Vol. XXII.—No. 533.

THE GOVERNMENT AND THE TELEPHONE COMPANIES.

Although it has been thought proper in official quarters that the remarks of the Postmaster-General should be withdrawn, few who have given any attention whatever to the relations existing between the companies and the Telegraph Department will believe otherwise than that those remarks sounded the keynote of the acquisition of the telephone companies by the State. We are quite of opinion with the Postmaster-General that the position of telephonic communication in relation to commercial pursuits is "unsatisfactory," and "that before long steps must be taken to place telephony on the same footing as telegraphy, either under the control of the Government or entirely with private enterprise"—our quotations are taken from the *Times*—and we further endorse the expression attributed to Mr. Raikes by our contemporary to the effect that the present system cannot be justified.

This expression on our part is in no way a sentimental expression, but one derived purely from the matter of fact position into which the relations and conditions existing between the Government Department and the telephone companies have drifted. We regard it as impossible that this condition can continue. Let us consider for a moment what are the facts. A Government Department created for the purpose of conducting for the advantage of the community at large, entrusted with special and exclusive powers to enable it to do so, the telegraph service of the country, and a series of telephone companies, each occupying an independent territory! The one transmitting telegraphic messages between office and office; the other transmitting, or allowing the subscribers themselves to transmit their communications equally from place to place over, so far, only a restricted area, but one which is constantly widening, and which ere long will doubtless embrace every town of note. Space will not permit our quoting in detail here the extent to which these connections have already gone, but we hope in our next to give a list of the chief towns within speaking communication of each other. Here it is sufficient to observe that very rapid strides have been made, especially in the manufacturing districts, in Lancashire, Cheshire, and Yorkshire, whilst Nottinghamshire and Leicestershire are stretching out their lines, and will not, apparently, be long ere they join their northern friends. In the South and West of England, and, again, in the Glasgow district, towns are being rapidly linked together.

Looking to the almost immediate future what does this mean? Simply that at no distant date the network of telephone lines will be as great, or nearly so, and the means of communication by telephone as general, as is that accorded by the Telegraph Departmental lines. Already do the telephone companies in many towns exceed the Post Office in their accommodation of the demands of the public for "call offices"—the call offices are more conveniently placed and more numerous than the telegraph offices. We do not refer to this in any manner as a reflection upon the Post Office Department, for we suppose that department can only establish its telegraph offices where post offices exist; but with the telephone companies there exists no such obligation, and hence they are able to more readily meet the demands of the public. All this, however, tends but to one result—the more complete competition with the Post Office. It is this competition which we conceive must sooner or later carry with it the more complete control of the telephone companies referred to by the Postmaster-General. We do not conceive it possible that such a condition of things can be allowed to continue by a branch of the State established for the purpose of conducting the telegraph business of the country; and we do not think if it were possible for it to exist that the existence of two such systems, under two controls—the one responsible to the country, the other partially to the Government and partially to their shareholders—could prove advantageous either to the country or to the companies. For these reasons, then, we say we can see but one result for the present condition of things, viz., the purchase, or the more complete control of the telephone companies by the State. How the State is to exercise more control than exists at present it is difficult to see unless it be by some arrangement which will practically merge the telephone with the telegraph service. Whatever may be the views publicly expressed by members of the Government, it is to be assumed they know their own mind, and possibly the course which they propose to follow. If this is so, then it is desirable that that course should be made known and acted upon without delay, instead of prolonging the existing undesirable condition of things.

It will no doubt be contended that it is hardly fitting for a government department to take over *in toto* the business as now dealt with by several of the telephone companies. Of course this is not desirable, nor is it necessary. The State has been entrusted with special powers for the purpose of developing telegraphic communication. The telephone has been declared, and no doubt is, in the eyes of the law, a telegraphic instrument. It has become, although under an independent and disjointed direction, an indispensable part of our telegraphic service. It is where it has so identified itself that its connection with that department, established for the purpose of concentrating and operating this form of communication, free from competition, so that the resources of the department might be untrammelled and free to work for the good of the community, should become still more identified. With the private wire, or other business purposes for which the companies have been established, the Government can have no desire to interfere.

WE are familiar with and can smilingly excuse the vagaries of French journalists when dealing with British titular distinctions. The Gallic "Sir Gladstone" and "Sir Salisbury" are certainly errors of which no well-regulated European journalist need be proud, but we can accept in extenuation the fact that the language and the men are foreign. What possible excuse can be urged, however, when a similar error is perpetrated in an American periodical? Sir David Salomons, as is tolerably well known to electricians on this side of the Atlantic, has written an excellent little work upon accumulators, which has reached a second edition. We reviewed the new and extended edition a few weeks ago; the work has now reached the States and the American scientific journals are reviewing it. Imagine our horror the other day upon reading the opinion of one of those journals, a reputable and in all other respects an estimable one, that "Sir Salomons is to be congratulated" upon having produced such a useful book! Our contemporary, we fear, has not been so attentive a reader of our own pages as for its own good it should have been, or it would have been more familiar with the name of this eminent amateur in electrical science and practice. This ignorance of English titles and of the proper name of an eminent English scientist is deplorable, and we are the more overwhelmed with grief because the offender bears our own name. Perhaps, however, our contemporary is guilty of no greater defection from the path of accurate journalism than that of too hasty proof reading.

WE hear that the House-to-House Electric Lighting Company is canvassing certain parts of the north of London for subscribers. Fifty inhabitants are required within a given radius, each to guarantee the use of 10 lamps at one guinea per year per lamp. If this information is correct, and our informant had himself been interviewed for the purpose of inducing him to accept the company's offer, we think the scheme is well worthy of support if the light is obtainable at all hours of the day or night. If such is not the case, people will probably still prefer to rely upon gas.

COMPLAINTS are rife respecting the telegraphic service between Paris and London. Important Bourse and Stock Exchange operations were greatly obstructed on Saturday through the delays in getting messages through, the average time taken in transmission being two hours. The *Financial News* says this was by no means an exceptional breakdown in the Continental telegraph service. In Paris they lay all the blame for the wasted time on the Channel cables, which are said to be too few for the service. Our financial contemporary thinks what is even more wanted than additional cables is a wholesale cutting down of the red tape which strangles the telegraph service in Paris, and, in fact, all over France.

WITHIN the last few months, writes *Electrical Plant*, a great deal has been said and written in the daily and other papers as to the benefits and advantages of electric welding, but as most of the confidence in such a process has been shown by those least acquainted with the true merits of the subject, scientific men and technical experts have not as a rule been stirred greatly by the wonderful, too wonderful, reports circulated. We have now before us a letter from a well-informed correspondent, who had been called upon to examine a pair of plates which were professedly welded by electricity in Paris. "After a quiet survey," he says, "taking hold of it by each end I struck it on a vice and found a plate in each hand. It seems that there had been an attempt to make a good scarph, but the actual fusion had not gone more than about $\frac{1}{16}$ inch below the surface. The plate bore a similar resemblance to that previously described." We do not doubt but that in the case of rods or bars a fairly satisfactory weld may be obtained by the use of electricity, but this method would appear hardly suitable for plates or other flat extended surfaces. It is greatly to be regretted that so much more should be claimed for such a process than it is really capable of performing, and nothing but discredit and mistrust on the part of the public will follow on the very definite and rose-coloured views expressed by those who have made electrical welding a successful laboratory experiment. It is one thing to effect a good joint between two small pieces of thin iron rods, and quite another to make a satisfactory weld in boiler plates for passing the marine surveyor.

EVIDENTLY there exists a belief amongst company promoters that the word "electric" and its congener "electrical" still possess the power of attraction which was so outrageously exhibited a few years ago during the period of the "electric boom." Else would several recently formed companies never have come into being. The latest to trade upon the credulity which the public displays where the, to it, unknown force of electricity is concerned, is the "Electrical Automatic Delivery Box Company." Most of us are sick of the sight of automatic boxes at railway stations and street corners, and are glad to believe that their end is nigh. The same senseless craving for novelty which for a time made these boxes so popular will inevitably be the cause of their ultimate doom, for it is as certain as that the night will follow the day that they will soon be forsaken for something newer, perhaps sillier, in littleness. The Electrical Automatic Delivery Box Company has applied to the public for capital with which to purchase patents which it appears do not yet exist and may never be granted; and the document in which the application is made bears evidences that the imagination was relied upon in its construction rather than any existing basis upon which expectations could reasonably be formed. We very much doubt whether any, even the smallest, success will attend the operations of the company; we doubt even whether it will ever go into operation at all. The scathing article in *Money* this week should have the effect of warning investors off.

THE Society of Telegraph-Engineers and Electricians has been requested by M. Berger, the Director-General of the Executive Committee of the Paris Universal Exhibition of 1889, to place itself in communication with such persons and firms as intend to send exhibits thither. A committee has been formed with Mr. Graves, the President, as Chairman, and circulars are now being sent to probable exhibitors to invite them to a preliminary meeting at the society's offices on Monday, 13th inst., at 3 p.m., with the intention of ascertaining their views. The Exhibition, as our readers are probably aware, is organised by the French Government, which places its *bonâ fides* beyond the shadow of a doubt, and intending participators in it may rest assured that the committee's dealings will be with M. Berger direct, and without any reference whatever to other kinds of exhibits. This gentleman is already favourably known to English electricians, especially to those who took part in the Exhibition of 1881, and when we say that Mr. Aylmer, the honorary secretary of the society in France, will again be at the service of his countrymen, we need add nothing further in commendation of the official part of the scheme. We will therefore only repeat the wish which was expressed last week that British electrical industries should be well represented. We have little doubt that such will be the case.

IN our issue of the 27th ult., we said of the Leamington installation: "It appears that two of the main cables had become 'disarranged and fused.'" This item of news we are informed by responsible authorities is absolutely incorrect.

THE opinions of leading theatre proprietors with regard to the relative merits of gas and electricity are always interesting. The Messrs. Gatti are about to demonstrate their faith in the younger illuminant by expending £15,000 for plant and other necessaries for lighting the Adelaide Gallery, the Adelphi, and one or two other buildings in the neighbourhood. One of the brothers recently expressed his belief that gas could never be so safe as electricity, while the latter could be relied upon quite as much as the other.

WE understand that there exists considerable opposition to the scheme for connecting up light-ships with the shore by means of submarine cables. We are told that the Trinity people object because they fear for the safety of their light-ships, the chances of these being run down becoming so much increased. Lloyds do not like the scheme, since there would be opened a fresh medium for fraudulent insurance. Ship owners are opposed to the project, for they fear lest their captains should take too frequent advantage of this means of communication, and possibly run needlessly into danger. Captains are against the design, as they anticipate they would be compelled by their owners, for the purpose of forwarding information as to the ship, to too closely approach dangerous localities. Light-ship men do not appreciate the proposal, as their duties would be considerably added to, and the risk of being run down increased. To all these objections it might be replied that the communicating of any intelligence not referring to ships actually in danger might be strictly prohibited, but the difficulty then arises as to how the installation and maintenance of these cables are to be paid for, unless indeed by a Government grant. The Mercantile Marine Fund not long since, at the general request of ship owners, reduced the light fees. The fund, we are told, is not in a very satisfactory monetary condition, and it would appear almost impossible to re-establish the old fees so as to assist towards the expenses incurred.

M. DUCRETET'S process of magnetising steel bars is worthy of notice. He takes a watertight vessel, let into the bottom of which are two pole pieces of soft iron, and these are placed upon the pole pieces of an electro-magnet. The vessel, filled with the tempering liquid, which can, if desired, be caused to circulate by means of pipes, receives the horseshoe magnet heated to the proper temperature upon the pole pieces at the bottom, where it is slid to and fro on the surfaces until cold, a current being passed through the electro-magnet all the time. Another method consists of bringing the steel plate in contact with the armatures, the vessel being empty of liquid, and then to fill the vessel rapidly with the liquid. This process gives a good temper to the metal. The degree of temper is not the only consideration. The ulterior work to be done by the bar thus tempered and magnetised also requires to be taken into consideration. An advisable precaution, indicated by the experience of workshops, is to employ two liquids for tempering; a first layer of water, for example, at the bottom of the vessel, covered by a second layer or bath of oil. The passage of the red-hot bar through the layer of oil before it comes in contact with the water is found to soften the metal, without depriving it of its power of becoming magnetised.

THE experiment recently made in Berlin of joining the underground mains of two central stations has proved completely successful, says *Industries*. Hitherto the network belonging to each station has been kept distinct from neighbouring mains, but as such a sub-division entailed greater administrative expenses and a greater outlay for reserve machinery, the Allegemeine Elektricitäts Gesellschaft resolved to join their two stations, one in the Markgrafenstrasse and the other in the Mauerstrasse, so that during the day-time and late at night only one of these stations need be kept at work.

THE *Daily Chronicle* devoted a leaderette a few days ago to the United Telephone Company's Bill to be introduced in the coming session of Parliament, but it had evidently not studied its clauses nor made itself generally acquainted with the controversy which has been proceeding with varying vigour for many years anent overhead wires. For instance, it condemns the company for not crossing streets with its wires at right angles and running generally with short spans, losing sight altogether of the fact that those are the very things the company seeks power to do by its Bill. It is the refusal of wayleaves and permission to affix wires to housetops, that necessitates those "diagonal sections" of which our contemporary complains. The United Telephone Company will be as well pleased as anyone when it can run its wires straight to the place it wants to get at.

WE heard the other day that a well-known American, whose name we unfortunately could not learn, was responsible for the following witty impromptu. Being asked by a beauteous damsel why wedding rings were always made of gold, he bethought himself for a moment, and then gave utterance to these charming lines:—

> A lovely maiden would be told
> Why wedding rings are made of gold:
> I venture to instruct her!
> Both Love and Lightning are the same,
> Love is the soul's electric flame,
> And gold its best conductor.

It is possible that the witty poet was, in his way, something of a cynic.

A NICELY got up little pamphlet has been issued by the House to House Electric Light Supply Company on "How to Obtain the Electric Light." It is issued with the view of affording full information to intending customers, the explanatory portion being compiled, by permission, from "The Electric Light in our Homes," by Robt. Hammond. Comment is needless.

ON THE DIFFERENCE OF PHASES OF CURRENTS, ON THE RETARDATION OF INDUCTION, AND ON THE DISSIPATION OF ENERGY IN TRANSFORMERS. EXPERIMENTAL AND THEORETICAL RESEARCHES.

By PROF. GALILEO FERRARIS.

(*Continued from page* 113.)

Comparison of the Results of Experiment with those of Theory in which no account is taken of the Retardation of the Magnetisation.

Let us suppose that the variations in the magnetisation of the iron, and with it the flux of induction which takes place within the coils of the transformer, are effected without any retardation simultaneously with the variations of the currents in the coils; that the coefficients of induction are constant; that the two currents, primary and secondary, be sinusoidal, and that the simplest relations prevail between the maximum intensity of the two currents and the mean phase of the currents.

Let us call i, i', the intensities of the two currents, primary and secondary, at the end of the time, t; e, the electromotive force which exists at the same instant in the primary circuit outside of the transformer; M, L, L', the coefficient of self-induction of the two coils; R and r, the resistance of the primary and that of the secondary circuit. We have, on this supposition, the two differential equations

$$M \frac{d\,i'}{d\,t} + L \frac{d\,i}{d\,t} + R\,i - e = 0,$$

$$M \frac{d\,i}{d\,t} + L' \frac{d\,i'}{d\,t} + r\,i' = 0;$$

putting $e = E \sin \frac{2\,\pi}{T}\,t$, the two differential equations are satisfied by values of the form

$$i = A \sin \frac{2\,\pi}{T}\,(t - a) \qquad i' = B \sin \frac{2\,\pi}{T}\,(t - \beta).$$

Transferring these values of e, i, and i', into the differential equations, and making the sum $\frac{2\,\pi}{T}\,t$ multiplied by $\cos \frac{2\,\pi}{T}\,t$ equal to zero, we obtain four equations which are sufficient to determine A, B, $a\ \beta$. It is then easy to verify the existence of the two following relations:—

$$\left(\frac{A}{B}\right)^2 = \frac{\frac{4\,\pi^2}{T^2} L'^2 + r^2}{\frac{4\,\pi^2}{T^2} M^2}$$

$$\tan \frac{2\,\pi}{T}\,(\beta - a) = -\frac{r}{\frac{2\,\pi}{T} L'}$$

putting

$$\frac{2\,\pi}{T}\,(\beta - a) = \phi$$

$$\frac{2\,\pi}{T}\,M = \mu \qquad \frac{2\,\pi}{T}\,L' = \lambda$$

the two relations become

$$\left(\frac{A}{B}\right)^2 = \frac{\lambda^2 + r^2}{\mu^2} \tag{3}$$

$$\tan \phi = -\frac{r}{\lambda},$$

whence follows

$$\left(\frac{B}{A}\right)^2 \cos^2 \phi = \left(\frac{\lambda}{\mu}\right)^2.$$

But with the notations previously established

$$\left(\frac{A}{B}\right)^2 = \frac{a}{b}$$

whence

$$\left(\frac{B}{A}\right)^2 \cos^2 \phi = \left(\frac{\lambda}{\mu}\right)^2 \frac{b}{a}$$

Comparing this value of $\cos^2\phi$ with the value $\left(\frac{c}{b}\right)^2 \frac{b}{a}$ we have

$$\frac{c}{b} = \frac{\lambda}{\mu} \tag{4}$$

Now $\frac{\lambda}{\mu}$ is constant; the causes of the variations of λ and μ are in the iron and are the same for both these magnitudes. Then there is verified the hypothesis which serves as a basis for the preceding formulæ, the ratio $\frac{c}{b}$ must be constant, independently of r.

But the values of $\frac{c}{b}$ obtained experimentally and registered in the foregoing tables increase regularly and very sensibly with the increase of the resistance, r. If we plot out the r as abscissæ and the corresponding values of $\frac{c}{b}$ as ordinates we shall have, according to the theoretical formula, a right line parallel to the axis of the abscissæ, but according to experiment it is a line passing through the increasing abscissæ and progressively deviating more and more from their axis. This line is the one marked I in the lithographic plate annexed to the present memoir. With irregularities which may be explained as errors of observation, it winds about a right line forming a certain angle with the axis of the abscissæ. The important circumstance must be noted that this right line, prolonged backwards, cuts the axis of the ordinates in a point the ordinate of which differs little from unity and is a little greater than the same.

The difference between the results of experiment and those obtained from the equation (3) proves that some of the hypotheses upon which this equation rests are not verified. But this cannot be due to the variability of the coefficients of induction, M and L', which the differential equations from which (3) is obtained assume as constant. In fact, we have already observed if with the approach of the iron to the state of magnetic saturation M and L diminish, the variation takes place in the same proportion in both, and hence it can have no influence upon the value of $\frac{L'}{M}$ or of $\frac{\lambda}{\mu}$. This is, on the other hand, readily explained by admitting the non-verification of the other hypothesis which we made in writing the preceding differential equations: the supposition that the induction is effected without any retardation. In other words, the discrepancy may be explained by admitting that as regards the duration of the period of the alternating currents, the retardations in the magnetisation and demagnetisation of the iron core of the secondary generator cannot be neglected: retardations which the foregoing differential equations assume as null.

If, in fact, the angle ϕ is always comprised between π and $\frac{\pi}{2}$, and as an increase of ϕ corresponds to an increase of $\cos^2\phi$, and since we have $\cos^2\phi = \frac{c^2}{a\,b}$ as there exists a retardation if ϕ is greater than the theoretical value, the value of $\frac{c^2}{a\,b}$ must result as greater than the theoretical value resulting from the equation (3). This is tantamount to saying that for given value of r or of $\frac{a}{b}$ the value of $\frac{c}{b}$ must result as greater than the theoretical value, greater also than $\frac{\lambda}{\mu}$.

As further it is known that ϕ decreases from π towards $\frac{\pi}{2}$ when r increases, and as to a given retardation and also to a given increase of ϕ there corresponds an increase of $\cos^2\phi$, so much the greater the nearer ϕ is to the inferior limit $\frac{\pi}{2}$, it may be seen that the excess of $\frac{c}{b}$ above the theoretical value $\frac{\lambda}{\mu}$ must come out the greater the greater is the resistance, r.

This is precisely the result to which experiment leads us.

Retardation of the Induced Current.

To see up to what point the foregoing considerations may explain the experimental results, and to see in this case what relations exist between the magnitude measured experimentally and the retardation in the magnetisation of the iron, let us seek to establish theoretically the relations among r, a, b, c, on the hypothesis that a certain time, θ, elapses between the moment in which there is verified a variation in the intensity of the current in one of the coils of the transformer and the instant when there is produced in this coil or in the other the corresponding electric force. We may then place the results of the analysis in comparison with those of experiment.

We will call R and r the resistances of the primary and the secondary circuit; e the electromotive force, a periodic function of the time, t, existing in the primary circuit outside the transformer; i and i' the intensities, at the end of the time, t, of the two currents primary and secondary and with the notations

$$\left(\frac{d\,i}{d\,t}\right)_{t\,-\,\theta} \qquad \left(\frac{d\,i'}{d\,t}\right)_{t\,-\,\theta}$$

let us represent the values which the derivatives $\frac{d\,i}{d\,t}$ and $\frac{d\,i'}{d\,t}$ have at the end of the time $t - \theta$. If, as it is here proposed to do, we admit that the electromotive forces of induction are produced with the retardation, θ, with respect to the variations of the current to which they are due, we have the two differential equations

$$\mathrm{M}\left(\frac{d\,i'}{d\,t}\right)_{t\,-\,\theta} + \mathrm{L}\left(\frac{d\,i}{d\,t}\right)_{t\,-\,\theta} + \mathrm{R}\,i = e \qquad (5)$$

$$\mathrm{M}\left(\frac{d\,i}{d\,t}\right)_{t\,-\,\theta} + \mathrm{L}'\left(\frac{d\,i'}{d\,t}\right)_{t\,-\,\theta} + r\,i' = 0 \qquad (6)$$

We suppose, also, that M, L, L′ represent constants. But such constants will depend, besides, on the conditions of the two coils, also on the circumstances which determine the retardation, θ; hence they differ from the coefficients of induction which we represented with the same letters in the foregoing paragraph: we will call them coefficients of apparent induction.

With the equations (5) and (6) the function, e, of the time being given, we have to determine the functions i and i'. If we suppose the currents sinusoidal, and if, T being given as the duration of the period, we put:

$$e = \mathrm{E}\sin\frac{2\,\pi}{\mathrm{T}}\,t \qquad i = \mathrm{A}\sin\frac{2\,\pi}{\mathrm{T}}\,(t - \alpha) \qquad (7)$$

$$i' = \mathrm{B}\sin\frac{2\,\pi}{\mathrm{T}}\,(t - \beta)$$

the problem is reduced to determine the values of A, B, α, β; and the four equations necessary for this purpose may be found on substituting in (5) and (6) the values (7), collecting in each equation the terms which contain the factor $\sin\frac{2\,\pi}{\mathrm{T}}\,t$ and those which contain $\cos\frac{2\,\pi}{\mathrm{T}}\,t$ and equating separately to zero the sum of the former and of the latter.

For our purpose it is sufficient to apply the explained procedure to the equation (6). If we insert in this, in place of i and i' the values (7), and in place of

$$\left(\frac{d\,i}{d\,t}\right)_{t\,-\,\theta} \text{ and of } \left(\frac{d\,i'}{d\,t}\right)_{t\,-\,\theta}$$

the values

$$\left(\frac{d\,i}{d\,t}\right)_{t\,-\,\theta} = \frac{2\,\pi}{\mathrm{T}}\,\mathrm{A}\cos\frac{2\,\pi}{\mathrm{T}}\,(t - \alpha - \theta)$$

$$\left(\frac{d\,i'}{d\,t}\right)_{t\,-\,\theta} = \frac{2\,\pi}{\mathrm{T}}\,\mathrm{B}\cos\frac{2\,\pi}{\mathrm{T}}\,(t - \beta - \theta)$$

taken from (7); if, then, in the equations thus found, we collect the sum of the terms multiplied by $\sin\frac{2\,\pi}{\mathrm{T}}\,t$, and that of the terms multiplied by $\cos\frac{2\,\pi}{\mathrm{T}}\,t$, and finally make each of these sums equal to zero we arrive at two equations :—

$$\mathrm{A}\,\mu\sin\frac{2\,\pi}{\mathrm{T}}\,(\alpha + \theta) + \mathrm{B}\left[\lambda\sin\frac{2\,\pi}{\mathrm{T}}\,(\beta+\theta) + r\cos\frac{2\,\pi}{\mathrm{T}}\,\beta\right] = 0 \quad (8)$$

$$\mathrm{A}\,\mu\cos\frac{2\,\pi}{\mathrm{T}}\,(\alpha + \theta) + \mathrm{B}\left[\lambda\cos\frac{2\,\pi}{\mathrm{T}}\,(\beta+\theta) - r\sin\frac{2\,\pi}{\mathrm{T}}\,\beta\right] = 0 \quad (9)$$

where there is put as above

$$\mu = \frac{2\,\pi}{\mathrm{T}}\,\mathrm{M} \qquad \lambda = \frac{2\,\pi}{\mathrm{T}}\,\mathrm{L}'.$$

If we transfer into the second part of the equation the terms having the factor B, then raise the two parts of each equation to the square and sum up, we have

$$\mathrm{A}^2\,\mu^2 = \mathrm{B}^2\left(\lambda^2 + r^2 + 2\,\lambda\,r\sin\frac{2\,\pi}{\mathrm{T}}\,\theta\right) \qquad (\mathrm{I})$$

which equation may be reduced to

$$\left(\frac{\mathrm{A}}{\mathrm{B}}\right)^2 = \frac{\lambda^2 + r^2}{\mu^2}$$

and coincides with the first (3) of the former paragraph if we suppose $\theta = 0$.

(8) and (9) may be written in the following manner:

$$\mathrm{A}\,\mu\sin\frac{2\,\pi}{\mathrm{T}}(\alpha + \theta) + \mathrm{B}\,\lambda\sin\frac{2\,\pi}{\mathrm{T}}\,(\beta + \theta) = -\,\mathrm{B}\,r\cos\frac{2\,\pi}{\mathrm{T}}\,\beta.$$

$$\mathrm{A}\,\mu\cos\frac{2\,\pi}{\mathrm{T}}\,(\alpha + \theta) + \mathrm{B}\,\lambda\cos\frac{2\,\pi}{\mathrm{T}}(\beta+\theta) = \mathrm{B}\,r\sin\frac{2\,\pi}{\mathrm{T}}\,\beta.$$

and if we then raise their numbers to the square and sum up we find this other relation

$$\mathrm{A}^2\,\mu^2 + \mathrm{B}^2\,\lambda^2 + 2\,\mathrm{A}\,\mathrm{B}\,\mu\lambda\cos\frac{2\,\pi}{\mathrm{T}}\,(\beta - \alpha) = \mathrm{B}^2\,r^2$$

which when we put

$$\frac{2\,\pi}{\mathrm{T}}\,(\beta - \alpha) = \phi, \text{ is written}$$

$$\mathrm{A}^2\,\mu^2 + \mathrm{B}^2\,\lambda^2 + 2\,\mathrm{A}\,\mathrm{B}\,\mu\,\lambda\cos\phi = \mathrm{B}^2\,r^2 \qquad (\mathrm{II})$$

Lastly, combining (II) with (I) we have

$$\mathrm{B}^2\left(\lambda + r\sin\frac{2\,\pi}{\mathrm{T}}\,\theta\right) + \mathrm{A}\,\mathrm{B}\,\mu\cos\phi = 0 \qquad (\mathrm{III})$$

In the formulæ (I), (II), (III) we can now eliminate A, B, ϕ and introduce the magnitudes a, b, c, which in our experiments are deduced directly from the readings on the electro-dynamometers. Introducing into the three equations the values

$$a = \mathrm{A}^2;\ b = \mathrm{B}^2;\ \cos\phi = \frac{c}{b}\cdot\frac{1}{\sqrt{\frac{a}{b}}}$$

they will be written:—

$$\frac{a}{b}\,\mu^2 = \lambda^2 + r^2 + 2\,\lambda\,r\sin\frac{2\,\pi}{\mathrm{T}}\,\theta \qquad (\mathrm{I}')$$

$$a\,\mu^2 + b\,\lambda^2 - 2\,c\,\mu\,\lambda = b\,r^2 \qquad (\mathrm{II}')$$

$$\frac{c}{b} = \frac{\lambda}{\mu} + \frac{r}{\mu}\sin\frac{2\,\pi}{\mathrm{T}}\,\theta. \qquad (\mathrm{III}')$$

Any one of these equations is a consequence of the other two. The other two are distinct, and establish relations between the magnitudes μ, λ, r, θ, depending on the condition of the transformer and of the circuits, the readings which in our experiments are made directly.

If θ is supposed $= 0$ the formulæ (I′), (II′), (III′) are reduced to

$$\frac{a}{b}\mu^2 = \lambda^2 + r^2 \qquad \text{(I}'\text{)}$$

$$\frac{a}{b} - \left(\frac{c}{b}\right)^2 = \frac{r^2}{\mu^2} \qquad \text{(II}'\text{)}$$

$$\frac{c}{b} = \frac{\lambda}{\mu} \qquad \text{(III}'\text{)}$$

and coincide with those deduced from the differential equations of the preceding paragraph in which no account is taken of the retardation of the induction.

(*To be continued.*)

SOME REMARKS ON THE PAST YEAR.

THE general application of the regulations imposed upon the telegraphic systems of Europe by the Berlin Conference progresses without meeting any particular difficulties; this fact merits remark since the decisions regarding the unification and division of the taxes throughout the European system occasioned at first some doubts as to the practical execution of these modifications.

The low tariffs over the Atlantic cables are undoubtedly of great advantage to the public, but the war of rates which has produced and maintained this cheap service cannot be indefinitely persevered in considering the loss it entails upon the competing companies. Rumours are current that a moderate tariff is likely to be adopted should some compromise be effected between the opponents. The attempt of the French Company to sever its connection with the pool has proved unsuccessful so far. It remains to be seen what results will attend the appeal against the decision of the courts. It is difficult to guess what the final adjudication may be, since any affair of importance is certain to be made use of by political wire pullers.

The conference held in 1887 on the protection of submarine cables, decided that the convention of March 14th, 1884, shall come into effect on May 1st, 1888, provided the various contracting powers shall have respectively adopted such measures as will assure its fulfilment. No doubt legislation in this direction is urgently required, but at these conferences the absurd spectacle is presented of petty States owning not a single mile of cable and represented at the conferences by men possessing no knowledge whatever of the nature or exigencies of submarine telegraphy, having voices in legislating on the questions involved.

The growth of the general employment of the telegraph has apparently necessitated an increase in the number of service messages relating to the traffic, out of all proportion to the number of paid messages. Taking the 10 principal European States as an example, we find that up to January 1st, 1887, there were 14,000,000 more messages transmitted than up to January 1st, 1886. Of these by far the greater number were service messages.

The submarine telegraph system has been augmented by new cables between Gibraltar and Tangiers, between England, Lisbon, Gibraltar and Malta, and between Malta and Zante. The Italian Government has seriously undertaken the connecting of many of its ports and islands, while farther eastwards new cables connect Assab and Massowah, Hong Kong and Shanghai, and Foochow and Formosa.

On the Peninsula of Malacca the States of Selangor and Sungie Ujong have been given a telegraph system, and in the French possessions of Annam and Tonquin there has been a very considerable extension of the land lines. The Chinese Government has apparently become aware of the important part played by the telegraph in modern times, and it is more than probable that before long the development of this means of communication will assume large proportions throughout the Chinese Empire.

In America the most important event has been the acquisition by the Western Union Telegraph Company of the lines of its most important rival, the Baltimore and Ohio Company. This virtually places a complete monopoly of telegraphic communication in the hands of the Western Union.

The Mexican lines have been carried into Yucatan, while the Brazilian land lines have been extended northwards to Para. Considering the disadvantages, such as tropical vegetation, heavy rainfall, difficulties of transport, absence of intelligent labour, and last, but not least, want of money, both these countries have to contend with, the energy displayed in opening up telegraphic communication is worthy of all praise. In South Africa, mining operations in the Transvaal and Zululand have necessitated the extension of the telegraph system, while on the West Coast of Africa the prolongation of the submarine cables to Loanda has been followed by some not very important additions to the land lines on that coast.

There has been no remarkable extension of the principle land line systems in Europe, attention being paid rather to improvements in apparatus and system of working, the result being that the capacity of the existing lines will for some time to come prove sufficient for the requirements of even a largely increased traffic. The perfection attained in this direction can be appreciated when it is remembered that fifty years ago a speed of four to five words per minute was obtained with the use of five wires, while to-day the Wheatstone instrument transmits six hundred words per minute on a single wire.

The most remarkable development is, however, witnessed in the immense strides taken by telephonic enterprise, the United States leading the way in the employment of this means of communication. From the latter part of this statement Switzerland must be excepted, as before the end of the current year every part of the Confederation will be united by one single telephone system.

Electric lighting has, scarcely to a less degree than telephony, received great stimulus during 1887. With the rapidly increasing spread of this method of illumination the very serious question of protection against its dangers is daily demanding more attention, and the necessity of strict legislation on the subject is sufficiently established. The carelessness or indifference too generally shown with regard to the insulation and situation of conductors carrying the powerful currents employed in electric lighting is a perpetual menace to life and property. In the neglect of ordinary precautions the American electric lighting companies take the lead, as it must be confessed they also do in the almost universal employment of this mode of lighting throughout the United States.

The employment of electricity for traction and transmission of power has been steadily persevered in. The first-named application has proved a success, notably in America, where there seems to be a great demand for this method of propulsion on tramways. With regard to the transmission of power no satisfactory solution has yet been arrived at, with the exception of one or two instances, as to its commercial value when the source of power is at any considerable distance from the receiving machines. At short distances the employment of electric motors in factories has obtained very considerable usage in the United States.

The application of electricity to the propulsion of boats or launches has not yet reached beyond the initial stage, the difficulties connected with the employment of storage batteries being problems still to be solved.

Narrow Escape from Decapitation.—A locomotive engine driver and fireman had an extraordinary escape on the Chester and Denbigh Railway a few days ago. The wind had blown down the telegraph poles near Hawarden Crossing, and the wires were right across the track. They were into the wire entanglements before they were aware of it. The wire just missed the driver's face, but curling around the tool box swept it clean off the tender.

IMPROVEMENTS IN THE BERNSTEIN LAMP.

The lamp invented by Mr. Alexander Bernstein has recently been much improved, and the manufacture of the two-pole type is now discontinued. The present form of the lamp is shown in fig. 1, the light-giving conductor being a carbon rod supported on strips of copper, and the leading in wires of platinum fused into the glass and terminating in two brass pins. The lampholder, fig. 2, is specially designed for lamps taking 10 ampères current. On putting in the lamps, the two pins which form the terminals of the lamp are firmly held in the pocket of the holder by means of two small pegs (only one being seen in the cut). By removing the cup the holder can be conveniently wired. With these lamps Mr. Bernstein overcomes some of the objections to the use of lamps of high resistance, especially those of costliness and danger. A number of these lamps may be placed in single series each independent of the others, and in such a manner that while the light given by each lamp is absolutely constant, the expenditure of power always corresponds with the variation in demand made upon it according to the number of lamps in operation. In a system of this kind it is essential to have some means of preventing the extinction of the whole of the lamps on the circuit in the event of a single lamp breaking.

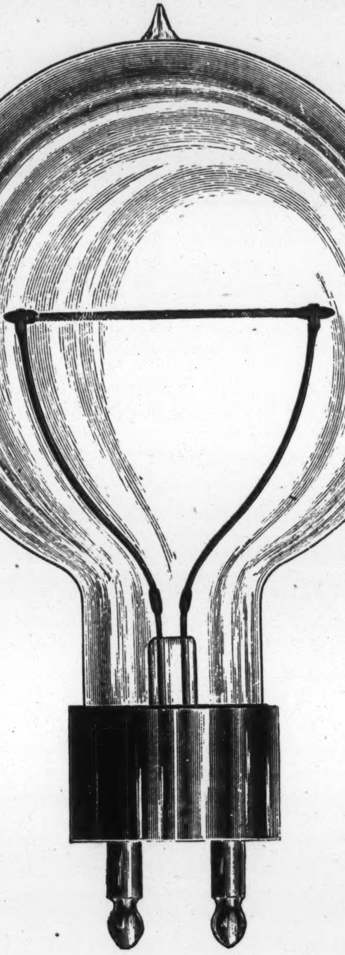

Fig. 1.

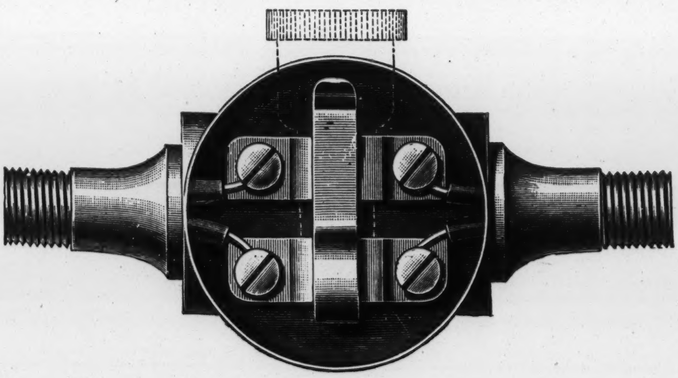

Fig. 4.

In 1882, Mr. Bernstein showed at the Vienna Electrical Exhibition an arrangement in which an electromagnet was placed in shunt to the lamp, and a permanent contact was produced by a spring in case the armature was attracted; but this was found too expensive and cumbersome to be suitable for general application. He now uses a chemical contact plug (as shown in full size in fig. 3), which consists of an insulated knob and two cylindrical brass pieces, held together by strips of vulcanised fibre. The upper brass cylinder contains a small piston, pressed down by means of a spring; the lower cylinder contains a screw, which has a recess for the reception of the small head of the piston. This recess is filled with a mixture of oxide of mercury and carbon which has normally a resistance of about 200 ohms. If the plug is put into the plugholder, as shown in figs. 4 and 5, it is placed in shunt to the lamp, the resistance to the latter being about 1 ohm. It is therefore apparent that normally only a small proportion of the current goes through the plug; but if the carbon should break, a much larger current passes through the plug, and local heating takes place in the mixture, which is thereby at once reduced, and a contact of practically no resistance is formed.

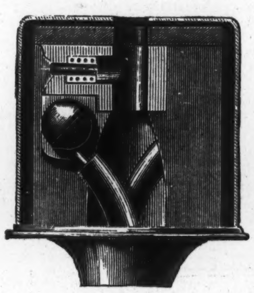

Fig. 2.

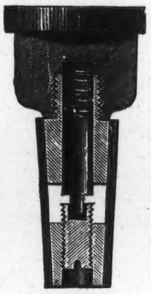

Fig. 3.

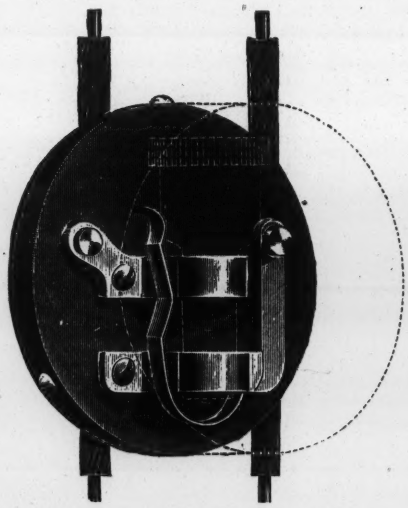

Fig. 5.

The bracket plugholder, shown in fig. 4, is used in connection with the usual fittings, and is shown here with the ornamental cap removed, the plug being indicated by dotted lines. The construction is plainly shown in the drawing. Two metal castings fastened on an insulated base receive the conducting wires and the contact plug. A flat spring is fastened to the lower casting, and held back from the upper casting by the plug. If the latter is removed the spring makes contact, and no light can be obtained in the lamp. This arrangement is made to prevent the use of the lamp without the interposition of a plug.

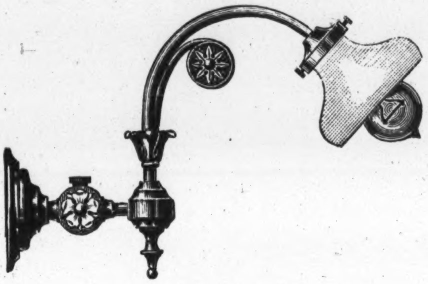

FIG. 6.

The Bernstein Electric Lamp Company now supplies complete fittings, made in polished brass, of which a number are exhibited at its show rooms at Commercial Road, Pimlico, fig. 6 giving a fair idea of the prevailing style of patterns.

Altogether the details of the Bernstein system of electric lighting by means of low resistance glow lamps have been carefully worked out, and must be admitted to possess certain practical advantages, such as economy in cost of lamps and wiring, simplicity, freedom from danger, and moderate expense of maintenance.

THE PALMER DYNAMO.

MR. JOHN PALMER, of Charlton, Kent, has designed a new form of dynamo machine, a description lately appearing in our esteemed contemporary *Iron*. The principle, or, we fear, the want of it, is shown in a series of diagrams kindly placed at our disposal by the inventor. The lines of force due to the field coils do not pass through the armature as in a Gramme machine, but pass radially from the centre to the periphery, one pole being internal. The armature ring is divided into halves, and the inventor expects to get a continuous current from this machine, but we are sorry to have to point out that no current will be generated at all, because the wires that cut the lines of force on the outside of the armature cut the same lines in the reverse direction in the inside.

The problem of producing a dynamo which will have many armature turns and will give a continuous current without any commutator seems to have a peculiar fascination. Quite a large number of many turned "unipolar" machines have been designed to give high electromotive forces with no commutators. The attempt is generally made to dodge the lines of force by bringing the turns back through holes in the iron. Very considerable ingenuity is often displayed in these attempts, but lines of force absolutely refuse to be bewildered. The dynamo design before us does not depend on this particular form of the fallacy, but we would like to give intending inventors a piece of good advice, namely, to regard a many turn continuous current machine with only two brushes and no commutator as a physical impossibility.

The Calumet and Hecla Fires.—The fire in the Calumet and Hecla property, as we are credibly informed, says the New York *Financial and Mining Record*, is still burning with unabated force, though confined, it is thought, to the Hecla ground, and near the surface.

CONTINENTAL ELECTRIC LIGHTING: BEING NOTES OF A TOUR TO THE UNDERMENTIONED CITIES, FEBRUARY, 1888.

By B. H. COLLINS.

PARIS.

THE streets of Paris are not generally illuminated with electric light. The Jablochkoff electric light is used in some instances on lattice pillars 60 feet high and columns 20 feet high, notably near the Louvre, and in the Place de la Concorde.

Of the many installations in Paris, that of the new theatre, Nouvel Opera, forms a great attraction, this building being most sumptiously fitted up in every respect.

LUCERNE.

The Schwerzerhof Hotel, near the Quay Side, is of large dimensions, has five floors, and is fitted throughout with the electric light, both arc and incandescent lamps being employed. The fittings are substantial looking, as well as tasteful in design. In the season a good orchestral band plays in the grounds in front of the hotel, arc lamps being fixed outside the building to afford the necessary light.

The current for this hotel and several other buildings is supplied from the works of Gebruder Troller and Co., at Dorenburg.

There is a small private generating station which supplies an hotel in the neighbourhood with current for 250 lights. The dynamo is one manufactured by R. Alioth and Co., Suisse, and gives 150 ampères and 120 volts at 850 revolutions. It is fixed on a stone bed with sliding gear for tightening. It is driven by a semi-portable engine, made by Gebruder Sulzer, Winterbur. One man only is in charge of the plant, and appears to keep everything in proper working order.

There is a voltmeter and ammeter by R. Alioth and Co., fixed on a board on the wall for testing.

COMO.

The electric light has recently been introduced for the first time in this beautifully situated city. This preliminary installation consists of five arc lamps fixed in the "Giardino Publico," or Public Gardens, four of them being placed on poles 30 feet high outside a "Padiglione Excelsior," or café, and the fifth lamp being placed on the main road, about 50 yards off. About 10 yards off this road, in a shed enclosed in a large yard, the dynamo ("Burgin" type, made by Altorf Bros., of Bale) is fixed on a stone bed 1 foot 6 inches high.

A semi-portable engine and boiler (local make) provides the motive power. There is an ammeter (indicating 8 ampères when the lamps are at work) and a small resistance frame with coils fixed on one side of the engine-room.

One man keeps this plant in proper working order, the light being remarkably steady.

Outside this café numerous small round tables are placed, and a temporary stage in the open air is also provided for sundry humorous performances and concerts, the electric light beaming forth over all.

Doubtless further additions will shortly be made in Como now it has obtained a successful preliminary footing.

MILAN.

Electric lighting here is general throughout the greater portion of the city, both as regards arc and incandescent lighting.

In the principal buildings fittings of the most elaborate description are used, while in the less important houses plain iron pipe fittings are fixed.

The squares and principal streets are illuminated by arc lamps.

The large central station of the Edison Company, which provides the current, is situated in the basement of an oblong building, about 120 feet by 35 feet broad, in a narrow street a couple of minutes' walk from the Cathedral.

Eight old type Edison machines about 7 feet by 7 feet by 6 feet high (giving 800 ampères and 110 volts at 350 revolutions, driven direct by engines of Armington and Sims's manufacture) are placed in a row down nearly the whole length of the basement with an interval of a few feet between each. On one side there are four Thomson-Houston dynamos used for the arc lighting, the incandescent lighting being supplied with current from the Edison machines.

Some of the arc lamps in the streets are arranged on iron pillars about 30 feet high, while others are hung from an iron chain stretched across the street. Near one end of the chain there is a short iron rod screwed into an iron ring which tightens or loosens the chain as desired. In the justly-renowned marble cathedral the electric light is used, but the usual candles continue to hold their sway at the high altar.

At the Scala Theatre upwards of 4,000 electric lamps are employed in the various rooms and body of the theatre. One massive gilt metal electrolier with frosted shades in the centre of the theatre contains 400 electric lamps. In the principal promenade room there are three electroliers with 108 lamps each, and in other rooms there are electroliers with 32 lamps each, 20 lamps each, and seven lamps each respectively.

There are six tiers of galleries to the theatre, and looking from the pit 300 lamps can be seen distributed in 60 brackets of five lamps each round the sides, 10 brackets for each tier or gallery. The switchboard arrangements are on the right hand side of the orchestra. There are others also in the basement of the building. The wires used throughout the building are insulated entirely with an asbestos covering.

TURIN.

At Turin there are three small central stations, at the Via Tubrario (Porta Susa), Piazza Castello, and Instituto Tecnico.

Over 500 H.P. is used in Turin for electric light. The ground is of a dry gravelly nature and particularly suitable for underground mains, which are placed about 2 feet deep and about 5 feet from the sides of the houses lining the streets. The Edison system of mains is used in several parts of the city. Near the station Siemens arc lamps are used and also at the Piazzo Milano and Piazzo Castello. The four iron pillars erected in each of these squares are each about 50 feet high with a bracket at the top from which the lamp hangs. They are substantially built and of neat design. At the foot of each lamp there is a testing box covered by an iron plate. In several arcades "Cruto" incandescent lamps with protecting well glasses are used at a distance of 9 feet from the ground, being pendant from a plain metal pipe.

In Via Garibaldi 50 Thomson-Houston lamps are employed to illuminate the street, and are suspended from curved brackets fixed in the walls about 20 feet above ground. The bottom half of the lamp globes is frosted to prevent a dazzling effect. Other streets in the neighbourhood are lighted with from 20 to 30 lamps respectively. The light is gradually gaining ground here.

GENEVA.

The electric light was temporarily employed here on the occasion of the festival in August last, Thomson-Houston lamps being used in the "Rue du Mont Blanc" and neighbourhood. It is proposed by a local company to put down a central station for supplying electric light generally as soon as matters have been arranged with the authorities. The swift-flowing waters of the Rhone as they leave Geneva will form an excellent means of providing cheap motive power, as already for other purposes 1,200 H.P. is being developed by five turbines fixed in the river, and the "Batiment des Turbines" is now being extended, which extension it is proposed to adopt for electric lighting at an early date.

COCKBURN'S SAFETY FUSES FOR ELECTRIC LIGHT CIRCUITS.

THE perfection of any new system is rarely, if ever, accomplished by any one person undertaking the working out of every detail in the system; it is when individuals pay particular attention to the perfecting of special parts that approach to perfection is attained. Although in the future it is probable that the employment of safety fuses in electric light installations will be rendered unnecessary, yet for some time to come they will continue to be important adjuncts to any system. No one perhaps has done more towards perfecting safety fuses than Mr. A. C. Cockburn, and those which he has recently devised, and which he described in his paper read before the Society of Telegraph-Engineers and Electricians, leave little to be desired as regards their satisfactory action. Our report of the paper just referred to will have explained the direction in which Mr. Cockburn has been working, but some illustration of the way in which the fuses are practically fitted may prove interesting.

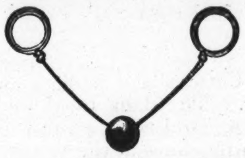

FIG. 1.

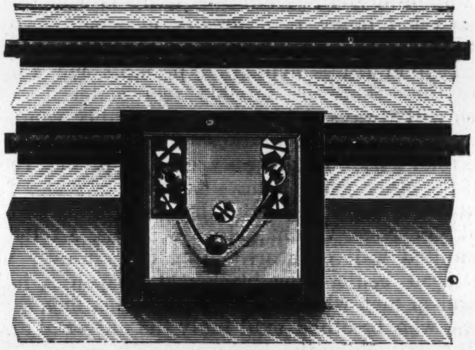

FIG. 2.

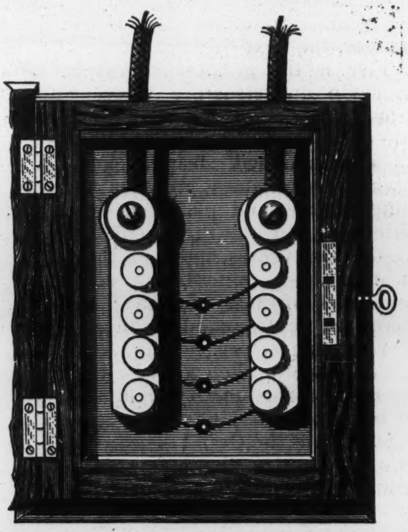

FIG. 3.

Fig. 1 shows the appearance of the fuse itself, the latter consisting of a tin wire terminated by rings which are placed on terminals and secured by the latter being screwed down; a leaden ball is cast over the centre of the wire, and by its weight causes the wire to part when the latter becomes sufficiently softened by the current.

Fig. 2 shows a "single pole cut-out for large current."

Fig. 3 represents a "main lead cut-out." In this case a number of fuses are joined in multiple arc, this arrangement being preferred to a single fuse with wire of larger diameter.

The care and attention which Mr. Cockburn has devoted to the subject is evidenced by the fact that the fuses will act with certainty within a margin of 5 per cent., a closeness which we believe has never before been attained. No deterioration by lapse of time is said to take place, a point which it is perhaps unnecessary to say is of the utmost importance. We should state that Mr. Cockburn's fuses are made of no less than 82 different carrying capacities, giving a range of from 1·1 to 50 ampères.

THE SAFETY OF THEATRES.

DISCUSSION of the means of safety presupposes a condition of danger. The dangers of the theatre! What are they? Grave moral risks, some will tell you, attach themselves to attendance at the theatre, or at any place of public entertainment, whether it be the Temple of the Absolute Drama or not—the risk of ruin to mortal body and immortal soul. Doubtless there is something of this: yet I fancy it is greatly exaggerated by the morbid imaginings of Puritanical narrow-mindedness. But beyond this—inclination prompts me to write above this—there are terribly real material dangers which will always, which must inevitably, compel the earnest consideration of those who would bestow no more than a passing, probably a contemptuous, thought upon the other contingency—fanciful or real. I have asked, What are they? But there was no need to ask. Brooklyn, Nice, Vienna, Moscow, Paris, Exeter, send up a united wail of heartrending despair over nearly 2,000 dead bodies—the blackened, shapeless, hideous remains of men who once were living; strong, sentient beings, who breathed exultingly the universal air, and strode firmly along the highway of life or toiled in its byways—of women who were beautiful, or if not beautiful were loving and beloved—of children, mirthful, innocent boys and girls, whose ringing, joyous laughter changed in one moment to terrified shrieks of horrible fear, the next to more terrible silence.

Yes, Fire is the greatest enemy to safety in the theatre, or in any structure where numbers gather. There are other dangers, agonising enough when realised—panic and the resultant block of outpouring streams of maddened, fear-stricken humanity, the block which sometimes precedes and causes panic, collapsing galleries and platforms—each has its black list of victims; but the Fire Fiend is the most deadly of all in destructiveness, and even the very fear of him, though he be absent, sometimes precipitates the others. Taking no heed of those who have met their death by being crushed or trampled upon in time of panic, 2,057 persons have perished in the last 11 years in fires which have broken out in theatres or similar buildings. These are horrifying figures: yet they have escaped being more terrific still by seemingly a miracle only. The fire at the Grand Theatre in Islington, that at the Bolton Theatre, that a few days ago in Madrid, convey an awful warning and make one shudder at the thought of what might have been. A few moments too late at the Grand, too late at Bolton, too late at Madrid, the Fiend rushed madly to Steubenville in Ohio, and there, although hours too soon for the full execution of his fell purpose, managed to snatch one victim.

The public mind is fickle: horrified to-day, it is sad only to-morrow, and next week forgets. Else surely should we have had a reform and a revolution in theatre construction and illumination long ere this. To some of us the memory of these catastrophes is ever present, and we with difficulty restrain our impatience when we witness the readiness with which people recover from a fright which has for a time paralysed them with terror, and continue as heedless as ever they were of the still existent danger. It may be that it is only because we are interested in some way or other that we retain with vividness the impressions created by repeated disasters. Unkind critics will doubtless point sneeringly at what is written here, then direct attention to the title of this journal, and suggest an inference which they will not intend shall reflect unadulterated credit upon the writer or his medium. But let them stay their hands and their tongues for a moment or so whilst I explain my position.

On the 6th of September last year I sat at breakfast in the coffee-room of a Manchester hotel, a morning paper before me. The newspaper was crowded with reports of the British Association sectional proceedings, and as I had had my full of the meetings themselves, I felt only a fitful interest in the reports. Presently I turned the sheet, and with startling suddenness these fateful lines met my gaze:

> "APPALLING FIRE IN AN EXETER THEATRE.
>
> "200 LIVES LOST!'

What! smiling, peaceful Exeter! A holocaust like that in Exeter! It could not be. Why, my father, mother, brother, and sisters lived in Exeter! Good God! could it be possible ——? I read and re-read the opening lines of the horrible story, but could take in nothing beyond the significance of those fearful headlines. Nor did I read the detailed account of the fire for days thereafter. I eagerly scanned the names of the victims, such of them as could be discovered, but recognised none that I knew. It was improbable that any of my relatives had gone to the theatre, I thought; indeed, I had spent a recent holiday in Exeter, and yet scarce knew the city contained a theatre. But there was the dreadful possibility, and my mind was absent from the work of the British Association till assurance came of their safety. The story will always be a painful one to me. I afterwards learnt that my family and I had had a narrow escape from bereavement: nothing more potent than the "No, don't go to-night; go to-morrow night with me!" of a friend had deterred my brother from being in the theatre on the evening of the fire. Then came, to deepen the impression, stories of the death in the fire of near neighbours of my parents: the mother of a family now left parentless almost next door; little girls, schoolfellows of my sisters, on the other side; acquaintances in all parts of the town, perished on that terrible night. My brother was near the theatre when the alarm was given; he witnessed the bringing out of the blackened corpses from the razed building, and saw them laid out in all their sickening horror in the hotel yard—fearful wounds, limbs dismembered, faces half gone and unrecognisable, charred bodies without heads, and mutilated heads without bodies—a sight the horror of which will never be forgotten! He saw this. I am thankful to say I only heard his narration, terrible enough indeed, but not the ghastly, harrowing sight itself.

This is a divergence, but it may be accepted as a proof of my personal concern, and a justification of my earnestness upon this topic. And here I would assert that my desire is to see theatres constructed upon lines which will ensure the public safety, and to advocate the adoption of the electric light only in so far as it will conduce to safety. As theatres are at present constructed, however, no one having any degree of intimacy with them, and any knowledge of the various illuminants, can doubt that the electric light is that with which the nearest approach to absolute safety can be attained. Mr. Augustus Harris, it must be admitted, some months ago came forth with some objections to the electric light, and he is a man who, whatever his acquaintance with the different means of illumination, knows a great deal about theatres. His arguments, however, were such as would apply equally well to gas lighting, or indeed to any form of public convenience, for the fancied danger depended upon contingencies of a negative order, involving the neglect of first principles and obvious precautions.

It is possible to cause a conflagration by means of the electric current, if it is deliberately set about; no one disputes that. It is also possible that a fire might result from the contact of over-heated wires with woodwork or readily ignited substances. But it is no more likely that a wire of inadequate cross-section would be used as an electric conductor than that a gas company would erect pipes which were not capable of securely conveying its vaporous commodity. The rules for the regulation of electric lighting installations compiled by Mr. Musgrave Heaphy for the Phœnix Fire Assurance Company have been adopted by nearly all the fire offices, and they are so strict that the most determined caviller could scarcely find fault with them upon the score that they leave loopholes for those who might feel inclined to practice economy at the expense of safety. Indeed, American opinion is that they demand an almost impossible condition of perfection in an installation; but American ways are not our ways, and the Phœnix rules are rigidly enforced here. Mr. Walter Emden, whose paper, read a week or so ago before the Society of Arts, has been the immediate cause of my attacking this subject, accorded them unstinted praise, and confessed that where they are enforced there is little need to fear a conflagration through any default of the electric light. He says:—"The opinion of the fire offices is that, with a thoroughly good installation carefully maintained electric light is absolutely the best method of lighting, but without such care in installing the offices would, I believe, rather have gas, or prefer to withdraw from the risk altogether." But even where they prefer gas, I venture to say that they are careful, before accepting the risk, to see that a "thoroughly good installation" is made, and after they have accepted it, are equally desirous that it should be "carefully maintained." Mr. Emden is outspoken enough with regard to the inconveniences, and even dangers, which may exist with even an electrical installation. He speaks of it as a misfortune that many people, believing the electric light perfectly safe, are lulled into a false state of security by its use, imagining that they need only use it to be safe.

A few cases are given in the paper of fires caused by the electric light, or, to be quite accurate, by the electric current, one being the burning of the "Temple Theatre," Philadelphia, in December, 1886, in which two lives were lost. While this fire undoubtedly originated with the electric system, it is scarcely fair to instance it as a representative case, for the structure was only a canvass one, and the lighting installation of a primitive and temporary character. In the other cases quoted no serious damage was caused, the fires being detected in an early stage and extinguished. Lord Sudeley, who presided over the meeting, thought Mr. Emden laid rather too much stress upon the danger which might attend the use of electricity. It was his opinion, and he thought those competent to deal with the matter would agree with him, that if electricity were properly applied, there was practically no danger. His lordship touched the right key when he further said, "If persons were employed who knew nothing about the subject, and proper precautions were not taken, of course danger would ensue; but if the wires were properly covered and there were the proper number of cut-outs, there could be no safer light." That sums up the whole difficulty with regard to electric lighting: employ trustworthy firms, of whom there are plenty, and you may depend upon the security of your lighting arrangements. Without wishing to speak depreciatingly of the usefulness of gas, it may fairly be contended that even with the most carefully-erected and supervised system, there must always be an element of danger from the very fact that it is necessary to employ practically naked lights in propinquity to materials of inflammable nature. When it is possible to shut up the gas flame in such a manner that nothing in its neighbourhood, above or around it, can either come into contact with it or become affected by the heat which it radiates, then, and not until then, may it be claimed on behalf of gas that it is comparable with the electric light for freedom from danger.

Mr. Emden devoted a great portion of his paper to a description of the system of the Asphaleia Company, devised by a number of scientific men in Germany who are intimate as well with theatrical technicalities as with the requirements of art and the powers of science. The object which this company has in view is the construction of perfectly safe theatres. The Asphaleia stage stands little risk of being burnt, for it is almost entirely made of masonry and metal. The floor of the stage only is of wood. Those who wish to know more of the details of this excellent system I would refer to the *Journal* of the Society of Arts for January 27th, in which Mr. Emden's paper appears. Here I will content myself with stating that although with the Asphaleian system gas may be used with much greater safety than in ordinary circumstances, the company itself uses and advocates the electric light.

The public discussions in the columns of newspapers and elsewhere of this great question of safety in theatres have done much since the Paris fire and that at Exeter to elucidate what is required, and what are the most feasible plans, to divest theatre-going of some of its present terrors. It is to be hoped that the interest excited by the paper by Mr. Emden will not die out without some tangible result being achieved in the direction of improvement, and that some such system as that of the Asphaleia Company will come into vogue in this country. Managers and lessees may be counted upon to fall in readily enough with new methods, provided those methods can be proved to be of marked advantage, for it is greatly to their interest to allay the uneasy feeling as to the existence of danger which from time to time arises in the breasts of their patrons. Whatever changes in actual construction we may witness in the time to come, however radical those changes may be, there is one thing which may be regarded as an absolute certainty, and that is that the electric light will come to be, instead of the exception as now, the invariable rule in theatres.

W. T. A. B.

SOME REMARKS ON MR. BROOKS'S PAPER.

I DO not propose to enter into a discussion as to the merits or defects of Mr. Brooks's system of insulating underground conductors, except to remark that a system which demands an average of 18 splices to $1\frac{1}{3}$rd miles of conductor does not appear very commendable. But I would wish to call Mr. Brooks's attention to one or two statements which he must have overlooked in forwarding the article for publication. It has been suggested to me that your esteemed contributor has selected this journal for working off some of those humorous fancies for which his countrymen are so justly famed, but I cannot for a moment entertain this idea.

The first joke perpetrated on your readers, or may I whisper, perhaps on Mr. Brooks, is at the hands of Dr. Cresson who claims that, because the German Government has decided that for the purpose of testing joints the leakage on a joint shall not exceed that obtained on three miles of cable, therefore since each length ($1\frac{1}{3}$rd miles) of the cable under notice contains 18 joints, each of them is to be taken as representing 3 miles of cable for the purpose of calculating the insulation of the whole! And this regardless of the fact that there might be a very large proportion of indifferent or defective joints which, according to this formula, must each be considered as representing 3 miles of sound cable! "De l'audace et toujours de l'audace," is a well recognised watchword across the herring-pond.

As to the remainder of the tests quoted by Mr. Brookes I notice many discrepancies, more especially with regard to electrostatic capacities, and among them Dr. Cresson's remarkable assumption that because the discharge equals the charge, the insulation must consequently be high. Would it surprise Dr. Cresson to learn that given a discharge instantaneously following the charge, a cable having very indifferent insulation might return almost the whole charge, and consequently the percentage of loss appear small. We are not told how long the cable was left free after charging, so the test as a proof of anything is valueless.

On reading the letters praising the qualities of rosin, rosin oil, and "London oil," one is reminded of those advertisements of some rare vintage, such as "fruity old port, recommended by the faculty for families and invalids at 18s. the dozen," rather than of a scientific and practical view of the material.

Further on, we are told that the method adopted by "European electricians" for the measurement of retardation is really more a process by which the development of "cross talk" and "disagreeable rattling" can be measured. Does this mean that to our already overburdened brains an unit of "cross talk and rattling" is to be imposed?

Mr. Brooks says that no perceptible difference in sound is noticed when employing one conductor only, as compared with the use of 53 conductors grouped so as to represent 75 times less resistance than the single line. This experiment, made with telephones at the extremities of a line only $1\frac{1}{3}$rd miles long, is scarcely conclusive. I should like to know the comparison between the resistances of the telephone transmitter and receiver, and the resistance of the line, and I would suggest to Mr. Brooks that while each additional wire lessens the resistance, the electrostatic capacity is at the same time increased, hence no improvement in distinctness of sound would be noticed.

The statement that a No. 18 wire, American gauge, has a resistance of 35 million ohms per mile, must be a misprint. The word "megohms" has evidently been inadvertently employed instead of "ohms."

I am willing to believe that an iron pipe 2 inches in diameter costs the same as a lead one of 1 inch diameter; I can accept the statement that into the larger iron pipe we can get four times the number of equal sized conductors as into the smaller lead pipe; but I draw the line when I am told "now, suppose we put 100 wires of equal gauge in the lead pipe and 100 in the iron pipe, the latter insulated to four times the thickness." I cannot accept this statement unless I am informed of the thickness of the original insulation. The operation would become impossible were the thickness of insulation on each side to exceed a ratio of 0·25 of the diameter of the conductor.

"Considerable work" has been done for electric lighting purposes with pipes and conductors made in lengths of 20 feet. That is, over 260 joints per mile, and, according to Mr. Brooks and Dr. Cresson, for the purpose of ascertaining the insulation we must consider (at the rate of three miles per joint) each mile of this core as actually representing more than 780 miles!

I must confess, with some amount of shame, that I fail to grasp the practical sequence to Mr. Brooks's theory of the circulation produced in the insulating material as a weak spot in one of the conductors. What sort of fault are we to pre-suppose? Should the defect be in one of the conductors immediately in contact with the iron pipe, might not the current take advantage of the position to "circulate" a little on its own account?

But I have already gone further than I intended, and want of time and space prevents me from dealing fully with this contribution. I leave those points I have not touched upon, and they are many, to the tender mercies of your readers, with the observation that "it is better to know less than know so much that isn't so."

UNDERGROUND.

The paper by Mr. D. Brooks on a new system of underground conductors, which you published last week, gives some interesting particulars regarding the use of rosin and rosin oil as an insulator. Mr. Brooks claims by his method a high di-electric resistance, a low inductive capacity, and economy over the methods now obtaining in all underground work.

From three series of data taken by American electricians, I see that a line of about $1\frac{1}{4}$ miles long laid in Philadelphia tests very well as regards insulation and capacity; but there are one or two things which one requires to be more fully informed upon to be able to judge of the superiority claimed for this process over those now in vogue. I presume the "covering" of the wire is cotton in one, two, or more layers, according to taste or circumstances, and I also imagine it is necessary to lay up a set of such conductors into a perfect cable if they are to be drawn into iron pipes in thousand feet lengths. If my presumptions are correct, I should like to know first if all moisture is absolutely eliminated from the cotton covering, and if so, whether it is not necessary to be careful in keeping the cable or set of conductors perfectly dry, so that they may be under the best condition (for electrostatic results) for their immersion in the rosin or rosin oil; and secondly, whether it is not impossible to perfectly surround the cable with the compound when it is lying at the bottom of the iron pipe, for in every case of actual contact of the cotton covering with the iron, I fail to see the use of the resinous medium as an insulator; perhaps later information as to detail of laying may throw some light on this point.

Mr. Brooks rather misunderstands the contention of the "European electricians" that the measure of retardation is the resistance of the conductor multiplied by its inductive capacity when he applies it to short distance telephony. I take it to refer to fast-speed telegraphy, and it is appreciable only over long distances of underground line, certainly not in lines of under $1\frac{1}{2}$ miles in length.

Mr. Brooks's statement that the "difference in *conductivity* between a conductor of 14 gauge and that of a No. 20 when used for telephonic purposes is not appreciable," is somewhat amusing. Why a "telephonic purpose" should be credited with such a remarkable performance I confess I don't quite see.

In electric lighting work, I think the objection noted above of the wire being not perfectly surrounded by the material which trickles into the pipe would be still greater, as the cables would be composed of heavy conductors whose weight would of necessity bring the cotton covering very close indeed to the iron.

Mr. Brooks's claim to high insulation is justified by the results of his Philadelphia experiences, and I wish him all success in trying to solve the difficult problem of underground systems; but I think a fuller description of his method, and data as to the possibilities of doing practical work in town or country in any weather, would cause the practical man to look more closely into his statements; and a more complete set of tests, say, on a single wire centrally placed in a length of pipe sufficient to gain approximately accurate information as to specific dielectric resistance and inductive capacity, would give the scientific men something on which to base an opinion for the guidance of their practical brethren.

CONDUCTOR.

The French Electrical Laboratory.—A considerable portion of the funds remaining over from the Paris Electrical Exhibition of 1881 was handed over originally to the the Minister of Posts and Telegraphs. This sum amounted to some £12,000, and has been turned over to the International Society of Electricians, under whose auspices the laboratory has been founded. M. de Nerville has been appointed general director of the laboratory, which it is expected will be shortly opened. Facilities will be given to private individuals and manufacturers for carrying out electrical researches.

REVIEWS.

On a Surf-Bound Coast; or Cable Laying in the African Tropics. By ARCHER P. CROUCH, B.A., Oxon. London: Sampson Low, Marston, Searle and Rivington.

Mr. Crouch was on the testing staff of one of the ships which laid the cable along the West Coast of Africa a couple of years ago, and the present volume embodies his experiences and observations during three out of the six months occupied by the expedition. To say that his narrative is faultless would be to accord praise far too high; but speaking for ourselves, we may say that we have found it very entertaining. Very little is generally known in England of the conditions of life on the West Coast of Africa, and still less of cable laying operations. Without being distressingly scientific or technical, the author has contrived to give not only a readable, but a very accurate account of the manner of laying cables, and the incidents attending the process; and we have little doubt that the charmingly clear and simple descriptions of scenery, and of the habits of the people met with along the coast, are equally faithful to nature. Here and there, regard for detail makes a portion of a chapter rather heavy reading; but the great fault of the book is in an opposite direction—the author, evidently in order to relieve the book of the suspicion of dryness and make it more interesting, descends to the inconsequent in dialogue. We imagine that he has striven to be realistic, and that the conversations reported all actually took place just as set down here. An illustration of the baldness with which the messroom talk is given will show how objectionable too close an observance of actuality may be:

> Talking of long watches, Mr. Shirley declares he was once on duty for eighty-four hours at a stretch, with intervals of three-quarters of an hour, during which he reposed in an easy chair on deck.
>
> "How long were the periods of activity?" asks Jenkins in a somewhat sceptical tone.

Here one would naturally expect a smart rejoinder, but with painful realism our author misses his chance, and apparently reproducing the conversation with the fidelity of a shorthand writer, proceeds:

> "I think we are all having a good spell now," remarks Mr. Thurston, as he rises from table to resume his watch on deck.

A greater literary success would undoubtedly have been achieved had the author sought concreteness, and given point—we have no doubt of his ability—to his dialogues. Conversations which may be very tolerable, and even entertaining, to the participants, rarely read well when written exactly as they have occurred. A little poetic license in this direction will greatly enhance the readableness of Mr. Crouch's next volume, in which, if it ever appears—its issue being conditional upon the success of the present one—the story of the latter half of the expedition will be told. There is one gem in this, generally speaking the dullest department of the book, however, which, notwithstanding that we fancy we have heard or read it before, we cannot refrain from quoting:—

> Mr. Shirley is as usual contributing very largely to the general entertainment. I hear him retailing a conversation he has just had with a cable hand:
>
> "You married at eighteen, do you say, Jackson? How came you to be so silly?"
>
> "Well, sir, you see, I was out of work at the time, and I had nothing to do."

Plenty of excitement is supplied, and plenty of amusement, what with harpooning sharks, diving for cables, interviews with dusky potentates, cricket matches and general interchange of hospitalities in the coast towns. These seas abound with sharks, and the description of a plucky act by the engineer-in-chief, who plunged overboard and dived to the ship's propeller in cool contempt of the danger of being eaten alive, deserves quotation. Here it is in Mr. Crouch's words:—

> Soon after, the engines are stopped, there is a short pause, and then they start again. At the same moment I see the spot of light fly off the scale, there is a chorus of "Stop her!" to the captain on the bridge, and Mr. Shirley comes running into the testing room to inquire if any fault has been indicated by the galvanometer. I tell him that the light went off the scale; and he replies, "Well, there is plenty to account for that occurrence, as the cable has just got foul of the propeller."
>
> By testing we find that the cable has either been severed altogether, or is laid bare to the core; and then, as there is nothing more to do in the testing room, I go aft to inspect the nature of the accident. The captain was at the time navigating the ship, and was trying to get up to the buoy. When the ship stopped the cable was washed underneath the propeller, and the engineer on the watch at once passed the word along to the captain not on any account to move the engines. The last man on the line either mistook the message or was late in delivering it, for directly afterwards "Slow ahead!" was rung in the engine room and the cable was immediately caught in the propeller.
>
> A boat was at once lowered, into which jumps Mr. White, taking with him several cable hands. They row round to the stern, bend a line on to the cable, and then half a turn in the reverse direction to which it last moved is given to the propeller to see if that would set it free. But it is firmly jammed, and there is great difficulty in judging how far it is entangled, as it is invisible from the surface, and the number of turns taken by the propeller after fouling is uncertain. In this dilemma Mr. White, without saying a word, quietly lays aside his helmet and his coat and solves the problem by plunging into the water, and, heedless of the probable approach of sharks now the ship is motionless, dives right down to the propeller and makes a rapid survey of it. When he comes up he merely says, "Tell them in the engine room to give her three half turns more in the same direction." This is immediately done, the line is hauled on to, and the cable comes away free, but dreadfully cut and twisted.
>
> In so speedy a fashion is rectified an accident which, but for Mr. White's prompt action, would probably have delayed the ship many hours and given us a great deal of work and trouble. As it is, the cable is hauled in till past the damaged part, cut, and still found long enough to splice to the buoyed end to which we have run, and which shortly afterwards is got on board. The splice is finished by noon, and the final bight of all the northern cables which we came out to lay is slipped amidst enthusiastic cheers.

Those conversant with the inner history of submarine cable laying will not need to be informed of the identity of Mr. White, but even those who are strangers to the Silvertown Cable Company and its staff may gather the information from the fact that Mr. Crouch has dedicated his book to "Matthew Hamilton Gray, Engineer-in-Charge of the Expedition." Many another friend and acquaintance we recognise in the story under other names than those by which they are known in actual life, and it must be admitted that the author has made good use of his opportunities of observing their peculiarities and characteristics. Altogether the West African cable expedition must have been a joyous time for those who took part in it, who, whatever the nature of the reception accorded it by the outside public, will treasure "On a Surf Bound Coast" as a valuable souvenir.

Turning Lathes. A Manual for Technical Schools and Apprentices. Edited by JAMES LUKIN, B.A. London: E. & F. N. Spon, 125, Strand, W.C.

This small book, although nominally merely a new work on the general subject of turning lathes, is evidently really written for the purpose of advertising, as much as possible, the wares of the Britannia Company, of Colchester. At the same time, however, the book is really one which deserves recommendation, as it gives in a very concise form such information as will enable an amateur who is desirous of paying attention to lathe work, to set about the latter in an intelligent way. The Britannia Company, in whose interest, as we have stated, the book is written, has certainly done much to popularise the subject of turning by introducing really serviceable tools for the purpose at a cheap rate, and "Turning Lathes" will, we think, bring the firm still more to notice.

Practical Physics for Schools and the Junior Students of Colleges. By BALFOUR STEWART and W. W. HALDANE GEE. Vol. I. Electricity and Magnetism. London: Macmillan & Co.

This book is written much on the same lines as the well-known larger work by the same authors; in fact, it is practically a condensation of the same supplemented, however, by several new lessons. We are extremely pleased with the book, which shows that the authors have completely cut themselves free from the trammels which seem to have bound even comparatively modern writers to an old fashioned stereotyped style; the illustrations of apparatus which have done duty *ad nauseam* for years, we had almost said centuries, past, have no place in Messrs. Stewart and Gee's book. The first portion on "Introductory Measurements" relates to the use of scale balances, micrometer guages, &c., minute but plain directions being given so that accuracy may be assured. Chapter I. deals with "Electrostatics—Elementary Phenomena and Laws;" Chapter II. with "Magnetism;" Chapter III. with "Voltaic Electricity;" Chapter IV. is devoted to the "Tangent Galvanometer;" Chapter V. relates to "Measurement of Resistance," and Chapter VI. to the "Quadrant Electrometer. Finally a useful Appendix is given, in which, amongst other things, plans of certain typical school laboratories, a list of apparatus, tools and materials, are shown; this should prove of the greatest possible help to those desirous of advancing scientific education by the establishment of technical departments in schools.

Framställning af de Vigtigare Elektriska Enheterna Med Tillämpning af Deras Dimensionsformler. Af C. A. NYSTROM: Stockholm, Lars Hökerbergs Forlagsexpedition.

This work is an exposition of the most important electrical units, showing the application of their formulæ of dimensions. There is certainly room for a work of this class, more especially in our own language, which this unfortunately is not.

Journal of the Society of Telegraph-Engineers and Electricians. No. 69, Vol. XVI. London: E. and F. N. Spon, 125, Strand, W.C.

This number contains discussion on the following papers:—"On some Instruments for the Measurement of Electromotive Force and Electrical Power," by Dr. J. A. Fleming and C. H. Gimingham; "Portable Voltmeters for Measuring Alternating Potential Differences," by Profs. W. E. Ayrton and John Perry, and a paper by Mr. A. C. Cockburn, on "Safety Fuses for Electric Light Circuits, and on the behaviour of the various metals usually employed in their construction."

THE LIGHTING OF THE BRIGHTON PAVILION.

THE question of the electric lighting at the Brighton Pavilion once more formed a topic of discussion at the last meeting of the Corporation. The Pavilion Committee reported the receipt of a letter from the Borough Surveyor, who reported that as, notwithstanding his frequent representations and its own promises the Maxim-Weston Electric Light Company had not completed its contract for placing the electric lighting of the Pavilion in perfect order, and had not, in his judgment, used sufficient dispatch about the work, he gave them notice on the 16th inst., pursuant to the 23rd clause of the specification, of his intention to dismiss them from the works after the expiration of six days from the service of the notice. He proposed to dismiss them accordingly, and under the authority conferred upon him by the contract to forthwith employ other contractors or workmen to complete the work. The notice would expire on the following day. It was resolved by the committee to approve of the steps taken and intended to be taken by the surveyor. The committee also announced the receipt of a letter from Mr. Hugh Watt, the chairman of the Maxim-Weston Electric Lighting Company, Limited, with reference to the notice served upon the company by the surveyor, and complaining that in consequence of unnecessary interference and contradictory orders it had been rendered impossible for the company to execute the work within the specified time. He also forwarded an account for the work done, and stated that unless the same was approved within a week, the company would instruct its solicitor to issue a writ.

In moving the confirmation of the proceedings of the committee,

Alderman ABBEY said it was intended to take proceedings against the company to compel them to complete their contract, and if they did not do so for the Corporation to carry out the remaining work themselves, deducting the cost from the amount at which the contract was accepted. The contract, he contended, should have been completed six months ago.

Mr. DANIEL seconded the resolution.

Mr. BERRY pointed out that the company complained of interference. Did that refer to the action of the surveyor?

The MAYOR: You had better not discuss that.

Mr. HALL said that they would exercise good sense in not entering into a discussion of the matter, and eventually the proceedings were passed.

LIGHTING A WEAVING SHED.

AN important installation of incandescent lamps has recently been completed by Messrs. Hanson and Charles, of the North Bridge Electrical Works, Halifax, at the mills of Messrs. Merrall and Son, manufacturers, of Oxenhope, near Keighley. The weaving shed, warp dressing rooms, piece rooms, &c., were lighted up with a total of 500 incandescent lamps, principally of 16 C.P., but a few 32 and 50 C.P. lamps were used where a particularly good light was required for coloured goods.

Two "Luther" dynamos, 15 units each, of the firm's special single magnet (composed of soft charcoal iron wire) type, equal to an output for 250 lamps each at 90 volts, with a speed of 600 revolutions per minute, were used. The wiring and switching arrangements were such as to enable any and every part of the installation to be run separately from either dynamo, or from both combined. In ordinary working the dynamos are coupled together, dividing the load. The dynamos are on slide rails for tightening the belts, and are driven direct from the flywheel of the engine, which is 8 feet in diameter, and of sufficient width to take two 8-inch belts. The diameter of the dynamo pulleys is 24 inches. The whole of the insulated cables and wires for the installation were supplied by Messrs. Walter T. Glover & Co., of Salford, Manchester.

A very fine and large slate switchboard has been fixed in the engine room, 5 feet long by 2 feet 6 inches wide and $2\frac{1}{2}$ inches thick, containing 36 "Rose" switches with cut-out to each, two main dynamo switches, and voltmeter and switch. All the switches are fixed on the board, so as to avoid any local switches; all are therefore in the engine room under the care of the attendant, rendering any tampering with a switch quite impossible. It will thus be seen that the entire control of the various circuits is centred in the dynamo room. The lamps are so arranged over the looms that they can be placed and remain in the best position for any operation on the part of the weaver, such as taking up broken ends, putting in fresh warps, &c. It was found, after some trials, that a fixed position for the lamp was unsatisfactory, so the above arrangement was carried out.

The power for driving this installation was supplied by Messrs. Timothy Bates & Co., Bank Foundry, Sowerby Bridge, and consisted of one of Pollett and Wigzell's patent horizontal compound condensing engines. The high pressure cylinder is $7\frac{1}{4}$ inches diameter and the low pressure cylinder $13\frac{1}{2}$ inches, both having a stroke of 24 inches and running at 150 revolutions per minute. One of the chief features of this engine is the automatic expansion valve, which is actuated direct by the governor, and gives beautifully steady running under all variations of load. The air pump is also one of Messrs. Bates & Co.'s patent horizontal type worked direct from the low pressure piston, and maintains a steady vacuum in the cylinder of $11\frac{1}{2}$ lbs., and although working at this high speed there is no noise whatever. When driving 436 lamps of 16 candle-power each the power was said to be only 42 indicated horse, a performance which, considering the very short time the machinery has been at work, must, if true, be considered very satisfactory.

The installation has now been running for about eight weeks and has given every satisfaction.

LIGHTING OF THE CARDIFF DOCKS BY ELECTRICITY.

FOR a number of years Sir W. T. Lewis has had under consideration the matter of the lighting by electricity of the whole of the Bute Docks, at Cardiff. The narrower the scope of the scheme the less economical appeared the electric light compared with its rival, gas. But as the dock system was extended, so proportionately did the comparative cost of the newer illuminant decrease, until eventually Mr. Massey (electrician to the Queen), who had been called in to assist Sir William, and who had hitherto reported adversely as to the adoption of electricity, was enabled to alter the tone of his opinion, and to strongly advocate the claims of the electric light. A couple of weeks ago the Bute Dock authorities practically commenced the carrying out of a scheme of lighting which—when the whole of the extensions have been effected—will make the Cardiff Docks among the best lighted in the world. It would scarcely be too much to say that when the work has been completed there will not be another dock system in the kingdom—excepting the Tilbury Docks, London—possessed of equal advantages in this respect. At present the authorities are engaged on the first section of the scheme, which forms but a small proportion of the whole. This comprises the supplying of 22 arc lights, each of between 2,000 and 3,000 candle-power. The lights are being placed at the entrance to the docks and basins. Acting upon a suggestion offered by Capt. Pomeroy (dock-master), the lights are carried in couples on poles between 35 feet and 40 feet high, which are so arranged by means of coloured lenses fixed between the posts and the Channel beyond, as to be adapted for the purposes of ordinary signalling with ships lying in the Roads.

The motive power is supplied by two engines made by Messrs. Davey, Paxman & Co., Colchester, and purchased from the makers at the close of the Indian and Colonial Exhibition, where they had attracted admiring crowds for months. These are capable of driving the machinery necessary for supplying 60 or 70 such huge lamps as we have described. The dynamos now in use, too, if their potential capabilities are not equal to those of the engines, are yet sufficiently strong to keep 33 lamps lighted. A preliminary trial of the machinery has already taken place, with markedly satisfactory results, and it is expected that within the period of a fortnight the whole of the plant will be in full working order, and each of the 22 lamps comprised in the first section of the scheme will be illuminating the dock and basin entrances. One of the most difficult of the operations connected with the work—that is to say, the laying of the submarine cables under the caissons across the dock entrances—as well as all the mechanical arrangements, has been successfully carried out under the direction of Mr. C. L. Hunter, mechanical engineer, Bute Docks. The purely electrical apparatus was supplied by Messrs. Crompton & Co., Chelmsford, and all that need further be said is that a commodious house has been erected for this and for the engines near the Bute Graving Dock, the place being so arranged that the existing staff of engineers can supervise the operations. Within a couple of weeks the public will have an opportunity of judging for themselves how vastly this last testimony to the enterprise and foresight of the Bute Docks authorities will improve the precincts of the docks after dark, and how largely it will assist in enabling vessels to leave and enter the port when natural light is not available.—*Western Mail.*

NOTES.

Glasgow and the Electric Light.—There seems to be an impression in Glasgow, that the contemplated electric lighting of the new Municipal Buildings has been made the subject of a job. "Tallow Dip" writing recently to the *North British Daily Mail*, says that the corporation some time ago invited tenders for the work, the necessary machinery to be placed in the basement of the buildings, but now he has reason to think this idea has been abandoned, and instead of the Town Council owning the machinery, current is to be supplied by a private firm in the town from a central station. This letter has been followed by one from "Electrician" who says that this change of purpose may be accounted for by the fact that the leading spirit of the Municipal Buildings Committee is connected by marriage with a member of the favoured electrical firm. This firm has a little machinery in a cellar, which it calls a central station, and from which it supplies one or two places in the vicinity. "Electrician" thinks the council owes an apology to the electrical firms who tendered for this work, for the trouble they have been put to when, as now seems evident, it was never its intention to award the contract openly and in the usual way.

Sleigh Racing by Electric Light.—According to the *Sporting Life* a wonderful sight was witnessed on the ice at Fleetwood Park, New York, on January 20th. The lake was lit by 500 electric lights, and a sleigh trotting championship was held under the most brilliant auspices. It was conceded by the numerous horsemen present to be the most wonderful performance with sleighs that has ever taken place.

Electric Lighting at Exeter.—The High Street, Queen Street, and other principal public thoroughfares in Exeter were illuminated last week by the Thomson-Houston system of electric lighting. The trials were a success, the night being dark and favourable to the experiment. An opinion prevailed that the lamps were fixed too high on the poles, and that more light was thrown on the upper portion of the houses than into the streets. Notwithstanding this, however, general satisfaction was expressed with the experiment.

Electric Lighting in the Temple.—The Benchers, who exercise lordship and dominion over the Temple, have, according to the *St. James's Gazette*, expressed their intention of lighting their territory with the electric light. No doubt the improvement will be a substantial benefit to the lawyers and others who inhabit those quarters. For some time past the library, and at times even the church, has been lit with the new light, which has given satisfaction in every way. Larger engines are now to be placed in a shed in the gardens, and it is hoped that it will be possible to supply every set of chambers in the Temple with electric light at a price that will make it generally acceptable.

Painting by Electric Light.—An experiment in the use of electric lighting was made at the Bradford Technical College last week. Mr. Durham painted a study of a head before the students of the art department, in the two hours usually occupied by him in demonstrating the method of painting, after the manner of Prof. Legros. The light used was a Pilsen arc light of 3,000 candle-power, softened by a ground glass globe. Screens of tissue and tracing paper had been previously tried, but they were found to obscure the light too much. Mr. Durham found that he could appreciate colour almost as well as by daylight, but some means of softening and diffusing the light has still to be arranged before it can be considered a perfect artificial light for artistic purposes.

Electric Lighting at Halifax.—An arc light installation has recently been completed at the iron foundry of Messrs. Haxby and Sewell of Halifax. Three large arc lamps of the "Luther" patent type taking a current of 25 ampères each, have been arranged over the travelling cranes; to prevent interference with moving gear, the lamps are arranged so that any light can be switched off or on. The dynamo employed is a 5-unit "Luther" dynamo giving 65 volts, and is driven by countershafts from the same engine as is used for the fan for blast furnace, going at 1,000 revolutions. The installation has been carried out by Messrs. Hanson and Charles, of the North Bridge Electrical Works, Halifax.

Electric Lighting at Hastings.—On Friday the Hastings Corporation considered a recommendation from the special lighting committee to the effect that it should be empowered, if it thought fit, to grant permission for the erection of overhead wires from the Electric Light Works to the Grand and Palace Hotels. It was pointed out that the members of the committee had no interest whatever in the electric lighting companies, but in the interests of the town they considered that the erection of the wires in question should be allowed. They were not likely to cause either inconvenience or danger. The motion was opposed by Mr. Eaton on the ground of the unsightly appearance of the wires, but eventually it was declared carried by six votes to three.

Extension of Lighting at Burlington House.—The Society of Antiquaries has recently concluded arrangements for the utilisation of the Royal Society's gas engine plant for the lighting of its premises. The work has been carried out by Messrs. Drake and Gorham. The charging plant is situated at some distance from the battery, and the current is conveyed underground by means of Berthoud-Borel lead covered cables, the connections and main switches are disposed in such a manner as to facilitate communication between the Elwell-Parker dynamo and either battery; at the same time the accumulators are interchangeable as far as the supply of the two societies' lighting circuits are concerned. The controlling and regulating switches adopted are of Drake and Gorham's patent ring contact pattern, and the battery consists of 33 of the firm's largest cells with all the latest improvements.

Lighting of a Yacht.—The steam yacht *Victoria*, which sailed from Gravesend on the 4th inst. for a pleasure cruise of three months in the Mediterranean, has just been fitted with a new electric light plant by Messrs. Browett, Lindley & Co., of Manchester. The plant consists of 150 incandescent lamps of an F_2 "Victoria" Brush dynamo, driven direct at 200 revolutions by a new type of vertical tandem compound engine recently patented by the above firm. The installation of the generating plant presented some difficulties, as the whole had to be carried on a wrought iron platform erected for the purpose in a corner of the main engine-room, and level with the top of the cylinders. The whole plant is very compact and entirely self-contained, and the engine is constructed to work either as a high-pressure engine with 50 lbs. steam from the donkey boilers and exhausting into the air, for use when in port, or to work compound with steam from the main boilers, which carry 80 lbs. pressure, and exhausting into the main condensers.

Electric Lighting in Glasgow.—From the *Glasgow Evening News* we learn that the electric light is advancing in Glasgow with silent rapidity. No less than seven large establishments are already fitted up, and in three of these the production of the electric light has been found cheaper than gas. Within the past fortnight two electric companies have been fitting up West End houses. Unfortunately, every care would not seem to have been observed to make the installations as perfect as possible. The story is told of an establishment where the electric light had been introduced being endangered by the neglect to "properly guard" a wire which, when snow fell, fused. The light was required, and as no illumination took place a search was at once instituted, when it was found that the current had set fire to the surrounding wood.

The Electric Light in a Carriage.—At the Lord-Lieutenant's Drawing Room last week in Dublin, some commotion was occasioned in the Castle yard by a carriage belonging to Dr. Meldon, which was lit by electric light. Four lamps were used—two inside and two outside. They were supplied by a six-celled storage battery. Some of the comments upon this incident during the week have been extremely amusing; not the least so that of the *Weekly Dispatch* which could not refrain from a sneer at the expense of the aristocrats who have only now discovered what the omnibus democracy of London knew a year ago.

Asylum Lighting.—At a meeting at Cupar last week of the Fife and Kinross District Lunacy Board it was agreed to invite estimates for lighting the asylum with electricity instead of gas. Admiral Maitland Dougall said the average expenditure for gas was £206 2s. a year, and as they had an engine and a boiler already at the asylum, the chances were that they would effect a saving, besides having a better light, purer air, and less risk from fire. The Admiral, with Mr. Gilmour, of Montrave, Dr. Lilburne, Kinross, and the Visiting Committee were appointed to make full inquiries and to report.

Ship Lighting.—Messrs. A. and J. Inglis last week launched from their shipbuilding yard at Pointhouse, Glasgow, a screw-steamer, named *Tarobu*, built of steel, to the highest class at Lloyd's. Her dimensions are 410 feet long, 46 feet beam, and 31 feet deep, the tonnage being about 5,000 tons. Accommodation has been provided for a large number of passengers, and the saloons and state rooms are fitted in a handsome and substantial way, every recent invention, including electric light, being furnished to add to the comfort of travellers.

The Telephone in Norfolk.—The South of England Telephone Company intends extending the existing trunk line between Norwich and Yarmouth to Lowestoft when a sufficient number of subscribers is obtained.

Hotel Lighting by Electricity.—The new company which is going to "run" the Victoria Hotel at Manchester (the property of the Manchester Corporation) has determined to light it throughout with the incandescent light, and we understand that operations will be commenced at once.

Lighting the Taff Vale Railway Works.—The electric light has just been adopted by the Taff Vale Railway Company at their Creosoting and Permanent Way Works near Cardiff. One of Messrs. Paterson and Cooper's Phœnix machines is employed to run both incandescent and arc lights in parallel. The shops are exceedingly well lighted throughout by Swan lamps, and Phœnix arc lamps are used for the outside work. The absolute steadiness of these lamps has been greatly praised, and it is probable that the system will be extended considerably. The work has been carried out by Messrs. J. B. Saunders & Co., electrical engineers, of Cardiff.

The Electric Lighting Act. — Lord Thurlow has followed up Major Flood Page's letter to the *Times* by announcing through the same medium that it is his firm intention to again lay his Bill, which last year passed the House of Lords, on the table of the House so soon as Parliament re-assembles. At the same time, he entirely concurs with Major Flood Page in hoping that Government may see fit to deal with the question this session, and enable him to withdraw his Bill and give his hearty support to their measure. He points out the objections to accepting the "compulsory purchase clause" as it stands, with no provision for goodwill, but adds that if it can be legally held and maintained that the valuation "as a going concern" sufficiently covers this point and affords sufficient protection to the public, he for one would be glad to drop the obnoxious word "goodwill."

Taunton Electric Lighting.—"Tauntonian," writing to local papers, says that Mr. Alderman Bruford, to whose opposition to the electric light in Taunton we have referred in former issues, is a shareholder in the Taunton Gas Company. We are not surprised. The writer continues:—"The electric light is so much appreciated in our town that there is little doubt that, notwithstanding the small extra cost, it will before long be extended to the whole borough. There is no disguising the fact that nothing that has been done of late years has so much conduced to the prosperity of Taunton as the introduction of the electric light." Mr. H. G. Massingham writes:—"In looking through the Taunton papers, I noticed that at a public dinner, which took place in that town last week, the chairman of the lighting committee, in responding for the Corporation, mentioned that so great was the satisfaction felt with the lighting of that portion of the town in which the electric light was used that the committee were desirous of extending it to the remainder of the town, and he thought that by the exercise of a little economy in other directions they would be able to do this without increasing the present rates."

Long-Distance Telephony.—It is proposed, according to the *Times* Vienna correspondent, to establish telephonic communication between Vienna and Budapest.

Telephone Mouthpieces.—Mr. A. C. Herts is now introducing amongst telephone users in this country an adjunct to the transmitter in the shape of a trumpet made of rubber, or other durable material, with a cone inside. When attached to an instrument the device is said to concentrate the tones of the speaker's voice thus enabling talking to be carried on with greater ease and certainty. We understand that the Swinton and other instruments are being fitted with this simple piece of auxiliary apparatus, and report generally speaks favourably of the result.

The Cables to the Continent.—A Reuter's telegram from Berlin states that in Wednesday's sitting of the Budget Committee of the Reichstag, during the discussion of the proposed purchase of the telegraph cables between Borkum and Lowestoft and Greetsiel and Valentia, Dr. von Stephan, the Postmaster-General, declared that it was intended to make a considerable reduction in the telegraph rates between Germany and England after the agreement on the subject had come into force, which would be on January 1st next. The charge for the Grundtaxe at present amounting to 40 pfennige would be abolished, and the rate per word, which is at present 20 pfennige would be reduced to 16 pfennige. The Minister added that the British Government would take over the Borkum-Lowestoft Line, and establish direct communication with London and the more important towns of England. The agreement was unanimously approved by the committee.

Bournemouth Telegraph Officials Dine Together.—An important meeting of postal and telegraph officials was held at the Waverley Hotel Bournemouth, on Tuesday evening, Mr. F. A. K. Hounsell, A.S.T.E., in the chair. Mr. W. Lynd, editor of the *Telegraphist*, proposed the Engineering department of the Telegraphs, coupling with the toast the names of Graves, Preece, and Kempe. After giving a brief sketch of the early days of telegraphy, Mr. Lynd said that the labours of such men as he had named had made telegraphy one of the most perfect popular institutions in the world. The number of messages dealt with at the Bournemouth office last year amounted to 200,000, showing an increase of 21,000 on the previous year. There is no friction between the two departments in this town. A telegram was received from the Secretary of the Postal Telegraph Clerks Association during the evening urging the staff at Bournemouth to join in the struggle for their modest demands.

Japanese Telegraphs. — From the report of the Director-General of Japanese Telegraphs to his Government, we extract the following data, which give an approximate idea of the condition of the service at the close of the year 1885-6.

	Telegraphs.	Telephone.
Population 37,868,987.		
Telegrams	2,542,156	...
Total length of lines	5,578	233
„ „ „ wires	15,129	409
Number of offices	280	...
„ „ instruments	536	189
„ „ staff	2,440	...
Receipts	769,691	...
Expenditure	899,695	...

The employment of female operators was adopted to a limited extent in 1884, the wives of telegraph clerks being allowed to qualify. At the present moment there are, however, only 21 females so employed. It is scarcely in a report of this nature that one would expect anything humorous, and we were consequently somewhat agreeably surprised to meet with the following remark in reference to a portable sounder, the invention of a Japanese and exhibited at an industrial exhibition in Tokyo. "It may not be without interest to mention here, although the occurrence was a matter *somewhat* to be regretted, that this portable instrument had the practical commendation bestowed on it of being stolen before the close of the exhibition."

He Wanted a Shock.—At the Birkenhead Police Court last week, a young man named Harry Simpkins, a commercial traveller, was summoned for wilfully and maliciously damaging an automatic electrical machine, the property of the Automatic Electric Apparatus Company, Limited. For the defence it was submitted that the defendant put two pennies into the machine, but could not get it to work. He accordingly tapped the glass slightly, with the result that it got broken. He offered to pay for the glass, stating that he had no intention to damage it. The magistrate was satisfied there was nothing malicious in the defendant's conduct, and dismissed the case.

Trade Reviving.—It is cheering in these days of agricultural and trade depression, says the *Essex County Chronicle*, to hear that any considerable industry in our midst shows signs of revival. On the occasion of the annual dinner of the Arc Electric Light Works and the Anchor Horticultural and Joinery Works, at Chelmsford, it was stated by the heads of these firms that the prospect was decidedly better now than it was last year, and that they hoped the men would be maintained in full work.

Personal.—We regret to learn that owing to ill-health Mr. Willoughby Smith has altogether retired from active work, and in consequence he has resigned his position as electrician to the Telegraph Construction and Maintenance Company, Wharf Road. We need scarcely remind our readers of the additions which Mr. Smith has made to electrical science by his many and valuable researches, and we trust that he may yet be enabled to add still further to our knowledge of electrical subjects. Mr. Willoughby Smith is a Past President of the Society of Telegraph-Engineers and Electricians.

Mr. Arthur C. Cockburn, who has been connected with the City and Guilds of London Technical College for the past eight years, assisting Prof. Ayrton prior to the latter's appointment to the Central Institution and Prof. Silvanus Thompson since that time, has now terminated his engagement, and has become manager of the Acme Electric Works. Mr. Cockburn's improvements in safety fuses are well known to electricians, and we have no doubt the newly-created firm of Cockburn, Day & Co., which owns the Acme Works, will pay special attention to this branch of manufacture.

Curious Case of Short-Circuiting.—A recent instance of short-circuiting the armatures of two dynamos used in the electric illuminating plant of a large mill is given by the New York *Electrical Review*, which states that it was occasioned by an unlooked-for cause. On examining the destroyed armatures, evidences of attrition were noticeable, while it was certain that no portion of the field pieces could interfere with the motion of the armature. These dynamos were driven from a shaft situated on the other side of a matchboard partition, with suitable apertures cut through for the passage of the belts. In the room on the other side of this partition a number of emery wheels were used in grinding iron, and the metallic dust in the air was drawn by the currents of air into the dynamo room and there attracted upon the poles of the field magnets, and held in a position sufficiently rigid to wear away the covering on the armatures and short-circuit them.

Society of Telegraph Engineers and Electricians.—At a meeting of students on January 19th, Mr. F. H. Webb presiding, the report of the committee was read and adopted, and the following were elected to form a Student's Committee for 1888: Messrs. C. G. Lamb, B.Sc., Charles Priest, J. N. Cooper, R. W. Paul, E. G. Tidd, A. G. Sanders, and J. Rance, jun. (hon. sec.). Mr. J. N. Cooper read a short note upon "An Error due to Refraction in Mirror Galvanometers." A short discussion followed, in which Messrs. Paul, Smith and Lamb took part. A further meeting took place on February 2nd, when Professor J. A. Fleming, D.Sc., occupied the chair. Mr. C. G. Lamb, B.Sc., opened a discussion upon the recent papers upon voltmeters, which was continued by Messrs. Gimingham, Smith, Paul, Bate, Dykes, Cooper and Dr. Fleming. The Council recently resolved that students transferred to the class of associates shall be permitted to attend student's meetings for one year after the date of such transfer.

A Self-Luminous Buoy.—Mr. George M. Hopkins describes a device in the *Scientific American* whereby vacuum tubes are caused to act as luminous buoys, the agitation of mercury in a high vacuum or in gas of high tension being employed to generate electricity and render the tubes luminous.

National Electric Light Association.—At the forthcoming convention of this Association the following papers are to be read:—A. L. Reinman, of Westinghouse Electric Company, on "Incandescent Lamps;" C. O. Mailloux, of Julien Electric Company, on "Storage Batteries;" F. J. Sprague, of the Sprague Motor Company, on "Dollar and Cent Question of the Motor Business;" P. O. Keilholtz, of U. S. Electric Ill. Company, Baltimore, Md., on "Fuel, Gas and Storage Batteries;" G. A. Liebig, of Baxter Motor Company, paper on Motors in general; W. W. Leggett and Jesse M. Smith, paper upon the subject of "Underground Conduits for Arc Lights;" T. C. Smith, of Allegheny Co. Light Company, Pittsburgh, Pa., upon the practical side of the distribution of alternating current from central stations; Prof. Thomson, of the Thomson-Houston Company, on "Necessary Tests for Arc and Incandescent Mains;" O. B. Shellenberg, Electrician Westinghouse Electric Company, upon the life of incandescent lamps and the general principle governing the distribution from alternating currents; Prof. Lange, Westinghouse Electric Company, upon the magnetic effect of currents upon various metals. The Subway Commission of New York were invited to be present at the convention and express their views as to the feasibility, practicability and success of underground conduits from their observation in New York. Like commissions in Brooklyn and Philadelphia were also invited, and if they could not attend, to be requested to send experts.

Alternating Current or Storage Battery?—Dr. Duncan seeks to show that while under some conditions the alternating method of distribution is more economical than the ordinary low tension direct system, yet even these advantages may disappear when the storage battery shall have been brought to a higher state of perfection. Dr. Duncan assumes that a station or system to work with the greatest economy must be operating at its maximum capacity for the greater part of the time. By means of storage batteries, in connection with a central station, the generating plant can be made smaller, and can be operated continuously, feeding either directly into the lighting circuits or charging the batteries for subsequent use. And, again, by arranging storage battery sub-stations, in which the batteries are charged by a high potential current from the main station and distributed at a low potential, all the advantages of the alternating system are obtained without its disadvantages, such as they may be.

The Copper Ring.—The French Copper Syndicate is not so theoretically omnipotent just now as it was a few days back, says *Money*. Large quantities of copper are being shipped from Japan and other parts of the world for Europe, and over these the Syndicate can of course have no control. We hear from good authorities in the copper trade at Liverpool that the supplies from America and elsewhere are greatly in excess of the anticipations of the Syndicate, and are so great that it would appear impossible for any financial combination to contend against them. The Syndicate may, however, obtain some assistance if what we hear from Madrid is likely to come into effect, namely, that the Government are seriously considering, in view of the local agitation at Rio Tinto, the necessity of prohibiting open-air calcinations in the Huelva district. Such a prohibition would at once close the works of both the Tharsis and the Rio Tinto Mines.

Ransomes, Sims and Jeffries's New Engine Catalogue.—This firm, owing to the increasing demand for its engines of all kinds, has prepared a special catalogue and price list, a copy of which has been forwarded us. This catalogue contains drawings and particulars of several new types of engines, both portable and stationary, forming one of the most complete series in the trade. Many of the engines included in the list are specially suitable for electric lighting urposes and are fitted with patent automatic governor expansion gear, very materially increasing the efficiency and economy of working. The action of this gear is such that the steam is always admitted to the cylinder at full boiler pressure, but only in such quantity as is sufficient to overcome the resistance, however variable it may be, and the contrivance is said to be the most economical that can be used for this purpose.

Telegraph Manufacturing Company's Catalogue.—We have received from this company a copy of its new illustrated catalogue and price list of electrical apparatus, which touches all but electric lighting and motor work (of which a separate list is to be published). The book is arranged for ready reference and is of a handy size for the pocket, the aim in its compilation being to make it as complete as possible in every section, so that it may form a contractor's *vade mecum* as regards estimating for telephone, telegraph, bell, and other work. All the blocks have been specially cut for this list (except the standard push patterns), and in most cases are so plain that goods can be safely ordered from the illustrations. The catalogue is intended solely for the wholesale trade, and all the prices are for quantities. In many respects this is the best catalogue of this character yet published in England, and will, no doubt, do much to make better known the wide range of apparatus and supplies now manufactured by this enterprising company.

Brussels Exhibition.—We learn that the Belgian section has obtained some space for the benefit of exhibitors who have been unable to send in their demand for accommodation prior to the 1st of January, upon which date the entries were closed.

Johnson and Phillips's Fluid Insulators.—Prof. H. F. Weber, of Zurich, who has recently tested the installation for the electrical transmission of power between Kriegstettin and Solothurm in Switzerland, prefers in his report to tests of Johnson and Phillips's insulators, and in a letter to the firm drawing attention to this report he says:—"The result is, it is nearly impossible to find any loss of intensity of current over a line of 8 kilometres, and the diminution of potential is due only to the resistance and not to a defect of insulation. Or in other words, your insulators are *perfect*."

Two Long-Lived Lamps.—The ordinary guarantee of life for Edison's incandescent electric lamps is 600 hours, but one lamp in the *Toronto Globe* office has just gone out after a most extraordinary life. It was put in about the end of November, 1884, when the Edison system was installed in the *Globe* office. It continued burning on the average five and a quarter hours every day, six days a week, until it had made a total of 5,292 hours.

Mr. C. M. McCarny writes to the *Electrical World*, giving an account of the phenomenal record of a Stanley (Westinghouse) lamp now in his possession taken from the Denver *Republican* office. This lamp has been in constant circuit for a period of 7,201 hours, or from January 12th, 1886, to January 3rd, 1888, on an average of 10 hours per night. The lamp was supplied from an S. H. Short compound-wound dynamo of 100 volts E.M.F.

The "Encyclopædia Britannica."—Vol. XXIII. of the "Encyclopædia Britannica," to be published next month, will contain articles on "Technical Education," by Sir Philip Magnus, and on the "Telegraph and Telephone" by Mr. Thomas Gray, assistant to Sir William Thomson.

Technical Instruction at Heriot's Hospital School.—Lord Balfour of Burleigh last week opened the new technical department at Heriot's Hospital School in Edinburgh. Mr. A. Y. Fraser, M.A., F.R.S.E., is to be the teacher in higher mathematics and physics, and students will be taken through a thoroughly exhaustive course, every arrangement having been made for practical demonstration.

Electrical Exhibitions.—Sir John Bennett gave an address on "Electrical Exhibitions at Home and Abroad" at the Polytechnic, Southampton, last week.

The Sunbeam Lamp.—Messrs. Sydney F. Walker and Olliver are introducing these lamps into the South Wales district, and a local paper states that they already have them running at several collieries.

Electric Lighting in London.—At the last meeting of the vestry of St. George the Martyr, the Roads Committee's recommendation that permission be given to the Anglo-American Brush Electric Light Corporation, to lay electrical conductors under the footway on the east side of Blackfriars Road, on the same conditions as those to be laid on the west side, was agreed to.

Sharp and Kent v. D'Humy.—Messrs. Sharp and Kent were informed yesterday morning that they had defeated M. D'Humy on all points in the recent lawsuit.

The Armstrong Battery.—Our readers might read with advantage a long article upon this battery in the *Financial News* of the 9th inst. We think the officials of the company must feel somewhat uncomfortable when brought face to face with the revelations contained in our enterprising contemporary.

The Physical Society of Glasgow University.—Among other interesting points referred to in Mr. Andrew W. Meikle's paper on the 3rd inst., the following comparisons of a number of Sir William Thomson's balances, independently standardised by the electrolysis of copper sulphate, were quoted. Two centi-ampère balances, standardised eight months ago, were at that time found to be in absolute agreement when compared with each other. These two instruments have been compared from time to time since that date with the view of checking their relative constancy, and are still in absolute agreement. Two deci-ampère balances, A and B, were also referred to. One of the above-mentioned centi-ampère balances was used to determine the constant of deci-ampère balance A; while the constant of deci-ampère balance B was taken from three separate electrolytic experiments which were in very close agreement, the first differing from the second by $\frac{1}{600}$ per cent., and the second from the third by $\frac{1}{80}$ per cent. These two balances, A and B, when compared together showed a difference of $\frac{1}{105}$ per cent., while deci-ampère balance A is still in absolute agreement with the centi-ampère balance used to determine its constant. As regards the larger instruments, the results were equally satisfactory. Taking in the whole set of standard instruments, the largest variation of constant for one instrument, when compared with the one next above it, was observed between the ampère and deci-ampère balances, and was then only $\frac{1}{60}$ per cent. Thus, at the time of writing, there were in the Physical Laboratory of Glasgow University a series of standard instruments capable of measuring from $\frac{1}{2}$ of a centi-ampère to 500 ampères, all of which were, practically speaking, in perfect agreement.

Electric Lighting in Brussels.—An important change has been made in the organisation of the management of the lighting of the town of Brussels (says *Industries* correspondent there). M. Aerts, manager of the gas works, having been appointed surveyor of public lighting and gas mains in place of M. Wybauw, who takes charge of the electric lighting, clocks, and telephones. At present the electric light installation of the town only comprises the generating station at the gas works, from which the Theatre de la Monnaie, the Grand Place, and the Theatre du Parc are supplied. It is, however, probable that the municipality will favour a project of erecting an electric light station in the centre of the town, which would serve the principal restaurants, cafés, and some public buildings. Negotiations to this effect have been commenced with the Société Industrielle of Brussels.

Train Lighting in America.—The Pullman Company has recently started running a train between New York and Florida which is lighted by electricity. The Electrical Accumulator and Lighting Company of New York has supplied cells to the Pullman Company to light two trains of six cars each, each car having 32 cells, in eight crates, carried in two boxes under the car. The batteries are kept charged by a dynamo machine placed in the baggage car. The company first tried to run the lights by obtaining motive power from the axles of the cars by means of cable gearing; but sand lies deep on some parts of the line, and the gearing became clogged. An 8 H.P. engine, fed from the locomotive, has now been fixed up alongside the dynamo. The cars themselves are most handsomely fitted up, and the whole journey, a distance of about 1,200 miles, is covered in 30 hours.

The Aldenham Institute.—Amongst the educational influences at work in what were once the suburbs but now form actual part of the metropolis, an important place must be assigned to the Aldenham Institute. This admirable institute is now in its tenth year, and is steadily increasing its means of usefulness. Situated on the borders of St. Pancras and Camden Town, it has attracted during the past year 377 youths to its various classes. The examination results just announced are exceedingly satisfactory. The electricity and magnetism classes were rather poorly attended, but other branches of technical training were well taken up. The average attendance at the Science and Art classes was 58. The total number of certificates obtained was 31, against 20 for the previous year. The trade technical classes had an average attendance of 17, and 14 certificates were gained, seven firsts (two honours) and seven seconds. The committee is earnestly appealing for funds to still further extend the work of the institute, more particularly in the department of technical education, and we wish it every success.

Action of Magnets on Liquids.—Prof. S. T. Morehead, of the Washington and Lee University, at Lexington, Va., gives the following description of an experiment in magnetism:—Into a glass tube of about 4 or 5 mm. internal diameter, a small quantity of liquid was introduced, forming a short cylinder. This tube was placed horizontally at right angles to the line joining the poles of the magnet, with the liquid nearly between the poles. When the current was turned on the liquid was very evidently repelled. Water was repelled through a distance of about a centimetre; wood spirit through a greater distance. By moving the tube in the direction of its length, the wood spirit could be pushed any distance through the tube. The amount of motion is, of course, a function of the resistances due to adhesion and friction, as well as of the repulsive force. The attraction of liquids is easily shown by the same methods.

NEW COMPANIES REGISTERED.

Australasian Gas Association, Limited.—Capital: £250,000 in £10 shares. Objects: To acquire concessions, &c., for lighting by gas, electricity, or other means in the Australasian Colonies, and to carry on business as gas and electric light engineers. Signatories: *H. L. Hammack, 59, Bishopsgate Street; *G. H. Haywood, 95, Upper Thames Street; *E. Moyes, 9 and 11, Fenchurch Avenue; *S. Spencer, 14, Great St. Thomas Apostle; W. C. Parkinson, Cottage Lane, City Road; *John Coates, C.E., Melbourne, 100 ordinary shares each; W. H. Eyres, Ballarat, 50 ordinary shares. The signatories whose names are preceded by an asterisk, and the Hon. C. Bent, are the first directors. Qualification: £500 of nominal capital. Remuneration: £30 per annum, multiplied by the number of directors for the time being, with an additional £100 when 5 per cent. dividend is paid, and a further £100 for each additional 1 per cent. dividend. Registered 3rd inst. by G. J. Gray, St. Clement's House, Clement's Lane.

Electric Traction Company, Limited. — Capital: £30,000 in £10 shares. Objects: To acquire inventions relating to the employment of electricity as a motive or other agent in tramways, railways, carriages, ships, boats, buildings, mines, or other places or things, and to the production, transmission, distribution, and application of power by electricity. Signatories (with 1 share each): Lord Bury, Quidenham, Norfolk; Lord Egerton of Tatton, Knutsford; Robert Macpherson, Willesden Green; Sir Robert Abercrombie, Bart., 7, Charles Street, N.; F. W. Hubel, Malden Crescent, N.W.; J. Paxman (engineer), Colchester; A. A. Cecil Keppel, J.P., Eccles Hall, Norfolk. The signatories are to appoint the first directors. Registered 6th inst. by Ashurst, Morris, Crisp & Co., 6, Old Jewry.

"Eclipse" Electric Lighting Syndicate, Limited.—Capital: £20,000 in £1 shares. Objects: To adopt an agreement of 4th inst. between John Garford and Willoughby Hamilton Power, and to carry on the business of an electric light company in all branches. Signatories (with 1 share each): *J. Garford, 3, Vernon Chambers, W.C.; *V. Robinson, 60, Gresham Street; W. H. Power, Silverdale, Sydenham: W. C. Loe, Isleworth; G. Garford, 33, Mornington Road, N.W.; H. M. Maclure, 68, Leadenhall Street; H. E. Robinson, 11, Poultry. The first directors are Sir Charles Clifford, Bart., and the first two signatories. Qualification: 200 shares or corresponding stock. Remuneration: £150 per annum. Registered 6th inst. by E. A. Wood, 4, Broad Street Buildings. Registered office, The White House, Telegraph Street.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Wynne's Electric Closed-Tube Tramways, Limited.—The statutory return of this Company, made up to the 3rd ult., was filed on the 4th inst. The nominal capital is £6,000 in £100 shares. 46 shares have been taken up, and upon 14 of these £30 per share has been called and paid, the remaining 32 shares being considered fully paid. Registered office, 5, Westminster Chambers, Victoria Street.

Series Electrical Traction Syndicate, Limited.—The registered office of this Company is at 11, Queen Victoria Street.

CITY NOTES, REPORTS, MEETINGS, &c.

Anglo-American Telegraph Company, Limited.

THE half-yearly ordinary general meeting of the shareholders of this company was held at Winchester House, Old Broad Street, on Friday last week, under the presidency of the Right Hon. Viscount Monck, chairman of the company.

Mr. T. H. Wells, the secretary, having read the notice convening the meeting, and the report, which appeared in the REVIEW last week, having been taken as read,

The Chairman said: It is now my duty to move the adoption of the report, and in doing so to give you a short epitome of the history of the company for the last six months. The first observation I shall make is, that during the past six months we have carried a very large traffic, a very much increased traffic, as you will see by referring to the report; but I regret that it is not satisfactory in one sense, for it has not yet become remunerative. With regard to the expenses there is very little to be said; they are pretty much, you will find, what they were in the corresponding half of last year. There are one or two items that are in excess, but they can be accounted for by special circumstances. One is the item of stationery at the stations, and the increase is caused by the very large supply sent out to Heart's Content in Newfoundland. Another item which is a little in excess of last year is that of travelling expenses, which was caused by moving clerks in the stations on the other side of the Atlantic at the time the 1869 cable was not operating, which was for about eight or nine months of last year. There is also an item for lodging allowances, fuel, light, and provisions, which is in excess of last year, and I am sorry to say that is produced by our having to provide extra provisions for Newfoundland stations through the loss of a cargo by shipwreck. There is also an item of repairs and furniture which exceeds that of last year, but which is due to special repairs at Heart's Content station amounting to £12. Those are the only things I will refer to in the working expenses. We have had a very considerable addition to our general expenses this year by the items of the repair of the '69 cable and the transfer of the shore ends of the cable at Valentia Bay. The repair of the '69 cable appears to me to be a most important circumstance; in fact, I think it almost marks an epoch in the history of telegraph construction and repair. You may remember that the '69 cable was laid down, as its name implies, in the year 1869, so that it had been 18 years under the water when it was lifted in a depth of 2,300 fathoms. It was lifted by our own ships, and I don't think we ought to discuss this matter without paying a tribute to the very great ability, energy, and skill exhibited by Captain Trott and officers and crew of the steamship *Minia*. I think it is only fair that this meeting, in discussing this matter, should admit how much we owe to the intelligence and energy of those men. We had to transfer the shore ends of the cable at Valentia from their original position, in which they were subject to abrasions from the roughness of the bottom upon which they were laid, to another position which had a sandy bottom, and in which they rest very easily, with far less risk of injury. The '69 cable has several times had to be repaired, and the other day I was talking to my friend Mr. Weaver, our managing director, about it, when I said that by this time it must be like the proverbial schoolboy's knife, which first had a new blade, and then a new handle, until it came to have not a single part of the original article left. Mr. Weaver corrected my impression by having a diagram made which I should like to exhibit to you. I think it would be as interesting to you as it was to me. It is a diagram of the bottom of that part of the Atlantic in which this cable lies. The bottom of the Atlantic in its configuration is not very different from the surface of the earth: it has its valleys and its hills, its mountains and its plains, and you will find in looking at the diagram that the injuries to the cable have been produced in only two or three places over the whole space between this country and America. In very large portions of the distance the cable has lain perfectly secure, because it has lain on a smooth bottom. Where it hangs down from mountains 2,700 fathoms deep—three miles high—it is subject to constant injury, and it is in these places that the ruptures have taken place. I think, as far as Atlantic cables are concerned, there is some consolation in the fact that this cable has for a great part of its length lain under water for nearly nineteen years without being injured in the slightest degree, for it shows that if we can only get a good bottom we may calculate upon very long lives indeed for our cables. The faults were removed by Capt. Trott and the steamship *Minia* most effectually, and the traffic through the cable was restored; but I am sorry to say, as you will see by the report, that it has given out in another position in somewhat the same direction as upon the former occasion, but a little nearer to Europe. We have had, in addition to our contest with nature, so to speak, in the bottom of the sea, a contest with the French Company in the law courts in Paris. Contrary to their own agreement they left what we call "the pool," and attempted either to set up for themselves or to join our opponents. We brought an action against them for so doing, and we have succeeded so far, and have had a decree entirely in our favour. Until that decree is reversed we may consider ourselves in the right. An appeal has been made, and until that is heard we cannot consider ourselves out of the difficulty. These are the matters which I call the history of the company during the six months. I now come to what is a matter of much more importance, and that is the contest which is going on between ourselves and our friends and the Commercial Cable Company, of America. Well, gentlemen, we have been accused of having what is called a fighting tariff. Now, I should like for one moment to refer back to the beginning of the contest to show that if there is any moral turpitude in instituting a fighting tariff, we are not the parties chargeable with the crime. I may say at the same time that the accusation sits very lightly on my shoulders, for if I could devise a fighting tariff by which we could beat our opponents, I would adopt it to a certainty. When the Commercial Cable Company commenced operations, the tariff was at 2s. a word. They reduced to 1s. 8d., and of course we were obliged to go to the same figure. We had not the same power over the public as the Commercial Company appear to have had at a later time when it charged 1s. per word against our 6d. That was the state of things, then, a year and a half ago. Your board, on considering with great care all the circumstances of the case, came to the conclusion that the only policy which we could adopt was to reduce the tariff, not for the purpose of fighting, but for the purpose of stimulating the traffic with the object of gaining a large revenue from the low tariff. That policy was fully stated here by me at the time. It was accepted by the great body of the shareholders as a wise and proper policy to adopt, and I am still of the same opinion. At the same time, if you will remember, I carefully guarded myself against naming 6d. or any sum as the ultimate point at which the tariff should be fixed. I told you that we were engaged on an experiment, that our design was to attain two objects, to stimulate the traffic by reducing the price, and to ascertain what tariff would give us a fair revenue, and yet not so large a revenue as to encourage further competition. Well, gentlemen, we said that we would give this 6d. tariff a fair and full trial, that we would make no alteration until we had ascertained how far the 6d. tariff would answer the two objects which we had in view. I told you at the time that the policy which we adopted, and which you approved, would make a considerable demand upon your patience and forbearance, and I ventured to predict also that it would largely increase the traffic over the cables. My vaticinations in both respects have been fulfilled, in one respect I am afraid absolutely, in the other only partially. I am afraid your patience has been sorely tried, and I am sure no one in the world regrets the necessity for it more than my colleagues and myself. The other prophecy that I ventured to make, that the traffic would be largely increased, has also proved true. You will see by the report that our traffic is 162 per cent. larger than before the 6d. rate was adopted, but unfortunately that is not enough to give you a remunerative return. I think we have given the 6d. rate a very fair trial. For the first year the increase was very large; for the last year it has been only 12 per cent., and although that may grow to a very much larger thing, I am afraid the trial of your patience would be so great that it would reach what is called the straining point. I think we have tried the 6d. tariff to its fullest extent, and I do not think there is that element of increase which promises to render it remunerative to the shareholders. Well, the question is, what are we to do? We have had meetings with representatives of the Commercial Cable Company which have led to nothing, because of demands on their part to which it was impossible that we could subscribe. My friend, Sir John Pender, at the Direct meeting the other day threw out a hint that we ought to have another conference. I can only say that I am entirely at one with Sir John Pender, and so is our board, that if anything could come out of a conference we are most anxious to hold one; we are perfectly willing to hear what is to be said on the other side, and for them to hear what we have to say. But I confess that my experience of the past has not been such as to render me very sanguine as to what the result of a conference might be. However, I am always willing to let hope triumph over experience, and if Sir John Pender can induce the other parties interested in the matter to come into the conference, he will not find us holding back, and I may say, on the part of my colleagues and myself, that we should go into the conference with perfectly unbiased minds, and if it is held we are prepared to carry on any further experimental investigations as to the amount of tariff that may be proposed, and if any proposals are made which seem to us likely to lead to a satisfactory and just conclusion, they will not find the Anglo-American Company an obstacle to their adoption. Gentlemen, with these observations I beg leave to move that the report of the directors and the accompanying statement of accounts to December 31st, 1887, submitted to this meeting be, and the same are, hereby received and adopted.

The Marquis of Tweeddale seconded.

Mr. Thomas Smith rose in support of the motion. He thought the report was a moderately satisfactory one, seeing that the directors had been enabled to pay 10s. on the ordinary shares and 20s. on the preferred stock for the last quarter, and to carry forward a balance of £2,344. For the same quarter of last year there was no dividend and no balance carried forward. The 6d. rate had now had a fair trial; it had been in operation nearly two years and they could not reasonably anticipate a much further increase. The question they had now to face was whether the present dividend of 2 per cent. per annum, supposing they could continue it, and he thought they could, was a sufficiently remunerative one to satisfy the shareholders. Without wishing in any way to hamper the directors, he would suggest that it was now time to consider the question of a still further reduction of the rate. It was of no use hiding from themselves the fact, of which both companies were fully aware, that this was a war in which one must give way. It was a well-known fact that the Commercial cables were making no dividend whatever, even if they were able to pay their expenses. The shareholders of this company had submitted very patiently for some time to a very small dividend indeed, but he thought they might reasonably say now that they had come to a crisis. An armed truce did not pay either party. They must have war, and it was his opinion that a 3d. rate would terminate the war. There could be but one end, and that was that the weakest party would have to come to terms. He hoped the directors would carry out the policy they had been compelled to adopt. With regard to the renewal fund, that was now in a very satisfactory condition. The whole of the amount invested returned an average dividend of $3\frac{1}{2}$ per cent., which was a splendid investment in these days, especially when they had their investments at their finger's ends. Their financial position was a sound and a strong one. If the shareholders were careless of the future and were satisfied with the present rate of interest, 2 per cent. on the ordinary and 4 per cent. on the preferred stock, the directors were in a position to continue the 6d. rate if they thought proper.

Mr. Chester said he would be glad if the chairman in his concluding remarks would throw a little light upon the question of the estimated balance. The dividends declared that day depended entirely upon the estimated balance which had been carried forward for two years now. He wished, too to know whether the French Company, which lost the day in the recent lawsuit, had not objected to the competency of the court which gave the decision. With regard to the 6d. rate, he was rather surprised to hear gentlemen come forward now and advocate that rate. That rate was brought forward as a fighting one.

The Chairman: No, no; certainly not.

Mr. Chester said he did not wish to contradict, but that was his strong impression. He protested against it at the time it was brought forward, and it would be found that the remarks he then made had since been justified by circumstances. He was very sorry to hear the proposal to reduce to 3d., and would remind them that they were travelling over precisely the same ground that the company had several times traversed within the past 15 years. This crushing out of opposition companies, what did it end in? Why, in other cables being laid. Did they think the Anglo-American Telegraph Company could say to the whole world, the traffic across the Atlantic is our own, and we are determined to oppose every company tooth and nail that opposes us? He would have been very much better pleased to have heard a proposition to go to some intermediate figure. If the rate were raised to something like 9d. per word that would pay the company, and meet the growing wants of the commercial community.

Mr. Wood suggested that two rates should be adopted, one of 9d. per word for pressing messages which were required to be sent at once, and another of 6d. for messages which might be kept back until the express messages had been sent off.

Mr. Newton said he feared Mr. Chester misunderstood the position. There had been nothing but squaring of opponents in this company, and as frequently as they compromised with their opponents so frequently did another competing cable come into existence. If a cable maker could find a purchaser for the cable, he would certainly lay it. Any arrangement they might make would be subject to some kind of pool, and once they had a pool the monopoly of which Mr. Chester spoke was at once created, and they could not avoid a monopoly, do what they would. It was inevitable. He (Mr. Newton) disagreed with the chairman with regard to the question of a fighting rate. There could be no doubt theirs was a fighting rate. They could not help themselves; they must fight with competitors. When the time came for squaring the Mackay-Bennett cables, as he had no doubt the time would come, it should be upon this company's own terms. He had said that with regard to former competitors for more than ten years. The telegraph engineers would go on laying cables and they would have to buy them, unless they adopted a policy of downright fighting rates and took the new cables at less than the original cost to the manufacturers. When they had beaten their opponents they could charge the rate which was commercially sound. There was no class of enterprise in the world which was more entitled to a dividend of 10 per cent. per annum than the telegraphs, but they would never get it until they adopted and persevered in fighting tactics.

Mr. Jackson was strongly opposed to a fighting policy. The result for the last two years of the war of rates that had been going on was that they had had a return on their capital of £1 6s. 3d. per annum. That, after 22 years' management of a public company by the most experienced men, and men of the highest position in the commercial world, was a result which justified great impatience, and was one under which the shareholders should not sit tamely. Mr. Newton had told them that they must have a monopoly. It was contemptible at this stage of commercial civilisation to talk about a monopoly in any business. The bottom of the Atlantic was no man's property; it was open to all. Mr. Newton said too they must crush opposition. Crush Mr. Mackay! He would like to see them do it.

Mr. Newton: I do not wish you under any circumstances to form the idea that you can crush Mr. Mackay. But he is a man of business, and you must deal with him as a man of business. As for crushing him, you can't do it!

Mr. Humphreys, Mr. Seeley and Mr. Daniell having spoken,

The Chairman replied to the observations of the shareholders who had taken part in the discussion. With regard to the estimated balance referred to by Mr. Chester, that phrase had been introduced because of course their ultimate net balance would depend upon the result of the lawsuit with the French Company. The decision in their favour gave them a gross sum of 30,000 francs, and 2,000 francs a day as long as the company adhered to its resolution to abandon the pool, but until the appeal had been heard they could not say accurately what their position was. Mr. Chester also asked whether the French Company was going to object to the competency of the court. He presumed the French Company would take every objection it could, but he was not in its councils and did not know what it would do. Mr. Wood could not have had a very large experience of that company, or he would not come forward with his suggestion as an original one. The question as to why they did not adopt a second and higher rate for express messages had been asked at nearly every meeting for many years, and he had returned the same answer that he would now give, namely, that the law would not allow them to do so. Mr. Jackson was manifestly impatient, and he (the chairman) was not surprised at it; but he might be impatient with results without being impatient with the management of the company. They were fighting against facts which could not be changed, and they had done their best in contending with those facts. Mr. Humphreys said that if the repairs had been paid out of revenue they could have paid no dividend. That was so. But the renewal fund was created for the very purpose of saving the revenue when repairs became necessary. Roughly, they had paid about £200,000 in repairing the 1869 cable, which was a very long way from sufficient to buy a new cable, which someone had suggested they should do. If for nothing else, it was worth while repairing this cable and keeping it going as a test of how long a cable would last effectively in the Atlantic. There was one thing that should not be lost sight of, and that was that later cables were of much better construction and likely to last much longer than this one.

The resolution for the adoption of the report and accounts was then put to the meeting and carried unanimously.

Sir Daniel Gooch and Mr. F. A. Bevan, directors, and Messrs. Joshua Dean and Francis Glass, auditors, were re-elected.

Mr. Jackson moved that the thanks of the shareholders be accorded to Captain Trott and the officers and crew of the *Minia* for the great skill and energy which they had displayed in repairing the cables under difficult circumstances.

Mr. Stockdale seconded, and the motion was carried unanimously.

A vote of thanks to the chairman and directors concluded the proceedings.

Cuba Submarine Telegraph Company, Limited.

THE thirty-third half-yearly ordinary general meeting of this company was held at the offices, 61, Old Broad Street, on Wednesday, Mr. J. de Mancha, the Chairman, presiding.

Mr. Jas. Scott, the Secretary, having read the notice convening the meeting,

The Chairman proposed the adoption of the report (which was published in the REVIEW last week). He said it was his good fortune to come before them again with a very good return. He thought they might congratulate the company upon its progress and success. The report was so full that it did not require much explanation. They would see that their messages, compared with December, 1886, had increased to the number of 1,528; the amount produced was £1,523 more than in the same time in 1886. The expenses were much about the same, and the item of repairs showed an increase of about £300, in consequence of the replacement of the harbour length of their cable, which was worn out. They had also built a new store for the spare cable. Mr. Keith said this was necessary so as to have cable at hand in case of need. They would pay this month the last half of the annual payment for the cable which they had contracted for, amounting to £1,875, and besides that they had in hand sufficient to pay to the preferred shareholders the 10 per cent. to which they were entitled, and 8 per cent. upon the ordinary shares. That was so satisfactory that it required no comment.

Mr. Low, a director, seconded the motion.

Mr. Cochrane asked how long the payments on account of the cable would continue, and said he thought the amount put to reserve was excessive. He believed, however, in the provision of a safe reserve fund, and the directors were entitled to lay aside the sum they thought necessary.

Mr. McLaren enquired as to the condition of the cable regarding which the chairman spoke rather ominously at the last meeting.

The Chairman said he thought he had before mentioned that they made a contract for the cable of which Mr. Cochrane spoke under which they paid £3,600 a year in two instalments until its whole cost, £48,000, had been defrayed. They had paid up to the present £28,000, and when the instalment now due was paid there would be about £19,000 still to pay. He thought this arrangement was to the advange of the company, for although they had no reason to fear that the cable would give out, if it did they were in a position to request the maker to repair it at once. He was very glad to say that the cable had worked most satisfactorily. Since the printing of the report they had received a telegram from Mr. Keith saying that the cable had developed a fault, the position of which he had discovered, and he had started to repair it; he did not think it would be a very expensive affair.

Mr. Keenlyside suggested that it might be better to make some arrangement with Mr. Hooper, the manufacturer of the cable upon which they were making half-yearly payments, whereby they could pay off the remaining indebtedness and start clear. He thought the reserve fund was being piled up to a greater extent than was necessary.

The Chairman said the amount put to reserve was the interest which the fund produced, and was therefore not so heavy a charge as might at first appear. As to the idea of paying off the money for the cable, he thought the money was better in their hands than in those of the contractor, and he was never anxious to pay a bill before it became due. Besides, although there was no reason to fear a breakdown, while they had the money in hand they had that extra security, and if they paid the money the security would be gone.

The resolution was then put and received unanimous assent.

The Chairman moved the declaration of a dividend at the rate of 10 per cent. per annum on the preference shares, subject to income tax, and a dividend of 8 per cent. on the ordinary shares, free of income tax, payable on and after the 9th inst.

Mr. Low seconded this motion also, which was agreed to, the meeting terminating with the usual votes of thanks.

The Submarine Telegraph Company, Limited.

THE report of the directors states that the accounts for the six months ending December 31st, 1887, show a net result which enables the directors to add the usual proportion of the receipts to the reserve fund, to recommend a dividend at the rate of 15½ per cent. per annum, and to carry over a balance of £209 4s. 8½d. to the next account. The same dividend was paid in the corresponding period of 1886.

In the six months of 1887 there were 27 pay days instead of the usual number of 26, and, therefore, the item of salaries includes 27 payments, while the receipts on the other hand only include the takings of 26 weeks. This fact accounts for half the increase in the item of salaries as compared with 1886. The other half of the increase is due to the annual increment to the clerks' salaries.

The drawback received from the Insurance Company at the expiration of the yearly policy in August, 1887, for the days the repairing ship was in port was £388 16s. 0d., which is in excess of the usual half-yearly charge for insurance of steamer by £63 6s. 0d. Consequently the item for insurance does not appear in the annexed accounts. The excess of £63 6s. 0d. will be carried to the credit of the insurance account for the half-year ending June, 1888.

All the company's cables are at the present time in good working order, but the Norderney cable, belonging to the Government, is interrupted, and the engineer is engaged in repairing it.

The number of messages transmitted in the six months was 1,695,860, against 1,691,280 in 1886, but the length of the messages was only 11·03 words against 11·11 words.

The board has long been endeavouring to obtain a renewal of the French concession, and on three occasions within the last two years they have had strong grounds for believing that those efforts would be crowned with success. Unfortunately the English Government have changed their policy, and propose to take into their own hands at the expiration of the company's French and Belgian concessions in January, 1889, the working of telegraphic communication with Holland, Germany, Belgium and France. This change of policy was communicated to the board in a letter addressed to the chairman of the company by the Chancellor of the Exchequer early in November, and the arrangements about to be concluded in Paris were thus frustrated.

The Postmaster-General has since that time informed the directors that Her Majesty's Government have decided not to grant any extension of the company's license for landing cables on the shores of this country, or to sanction a continuance of the working arrangement between the company and the Post Office, as defined by the agreement of July 11th, 1868, beyond the date fixed by that agreement.

The Belgian Minister of Posts and Telegraphs has also informed the directors that it has been decided not to renew the concession granted to the company for landing cables on the Belgian shore.

In these circumstances negotiations are being carried on between Her Majesty's Government and the board, and when these negotiations are terminated, the result will be make known to the shareholders without delay.

Taunton Electric Lighting Company, Limited.

ON Monday the first annual general meeting of the shareholders of the above company was held at the Castle Hotel, Taunton, under the presidency of Mr. W. H. Fowler, chairman of the board of directors. There was a good attendance. The report was as follows:—Your directors have pleasure in presenting herewith the first annual report of the company. The number of shares allotted is 873, on which the sum of £4,365 has been received, including the amount allotted on account of the purchase of the business. The number of private customers is now 20, besides the town lighting, and the number of arc lamps let at a rental is 65, besides the incandescent lamps in use, numbering 200. The accounts for the year show a profit of £315 15s. 5d. Your directors recommend that a dividend of 5 per cent. be paid, free of income tax. This will take £191 19s. 6d., leaving a balance of £123 15s. 11d. to be carried on for a reserve and depreciation account. In addition to the Taunton business, the company has carried out temporary installations in Bath, Weston-super-Mare, and Exeter. Deputations from various places have visited Taunton during the past year for the purpose of inspecting the company's works, machinery, and the lighting arrangements of the town; the general testimony being that it is one of the most successful installations yet carried out in the United Kingdom. The machinery has been maintained in excellent working order, those portions of it which are continuously wearing out being made good, and charged to income account. As the demand for the light increases, it is expedient to lay down more plant and machinery, and to enable the directors to do this, they hope that the public generally will take up more shares to increase the capital available for this purpose. Two of the directors retire by rotation, and are eligible for re-election. The names of the retiring directors (to be decided by ballot) will be announced at the annual meeting. The auditor, Mr. Albert Goodman, retires, but is eligible for re-election, and offers himself accordingly.

The Chairman moved, and Councillor Potter seconded the adoption of the report, with a dividend of 5 per cent. This was agreed to.

Mr. Samson and Mr. Lewis were re-elected directors, and Mr. J. A. Winter and Mr. C. E. Lance were appointed additional directors, the number being increased to nine. Mr. Massingham was re-appointed managing director, and Mr. A. Goodman auditor.

Mr. Wharton (of the firm of Laing, Wharton and Down) said that 50,000 arc lamps on the Thomson-Houston system were running in the United States, and there were 200,000 incandescent lamps. The St. Pancras station of the Midland Railway Company was to be lighted on that system, and it was expected that the L. & N.-W. Railway would follow.

Telegraph Construction and Maintenance Company, Limited.—Subject to the audit of the accounts, the directors propose to pay a dividend of 15 per cent. (£1 16s. per share), in addition to the 5 per cent. already paid, making 20 per cent. for the year 1887.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines of this company during the month of January was 4,064 estimated to produce £3,300, against 3,957 messages, producing £3,218 in the corresponding month of last year. The receipts for the month of October, estimated at £2,900, realised £3,024.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 31st January are £3,209, as compared with £2,831 in the corresponding period of 1887. The October receipts estimated at £5,371 realised £5,545.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending February 3rd, 1888, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £1,562.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending January 27th after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £1,764.

The Eastern Extension, Australasia and China Telegraph Company, Limited. The receipts for the month of January, 1888, amounted to £39,878, against £39,331 in the corresponding period of 1887.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of January were £1,943, against £1,904 in the corresponding period of last year.

The Eastern Telegraph Company, Limited. The receipts for January amounted to £56,161, against £53,435 in the corresponding month last year.

The Great Northern Telegraph Company, Limited. The receipts for January, 1888, £21,400; corresponding months, 1887, £20,400; and of 1886, £19,880.

The Brazilian Submarine Telegraph Company, Limited. The traffic receipts for weeks ended January 27th and February 3rd, amounted to £3,142 and £2,730 respectively.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month ending January 31st are £4,800.

CORRESPONDENCE.

Compound Winding.

We have just seen the letter from Mr. Garcke, manager of the Anglo-American Brush Electric Light Corporation, published in your issue of the 3rd instant. The complexion that this letter puts upon our case is entirely misleading and incorrect, as the following statement of facts will show.

We received a letter from the Brush Company, dated 19th of September, 1885, asking us to abstain from manufacturing, using, or selling compound-wound machines, and to render an account within one month, &c.

Again, on the 7th August, 1886, the Brush Company write us that they are informed that we are manufacturing dynamo machines which are in accordance with patent 2,003 of 1878, and they send us a list of firms who have granted licenses, and state that their practice is either to grant licenses on application to those who infringed or take steps with a view to prevent further manufacture.

The receipt of these letters was merely acknowledged, and it was not until the 22nd December, 1887, that a letter was sent to us by the Brush Corporation's solicitors, Messrs. Renshaws, asking us to furnish them with the name of a solicitor who would accept service on our behalf of such proceedings as their clients are advised to institute against us.

This letter was only received on the 26th of December, and on the same day intimation was sent them by our lawyers, Messrs. Davidson and Syme, as follows:—"We are prepared on behalf of Messrs. King, Brown and Co. to accept service of any proceeding you may institute against them, but you will, of course, understand that the proceedings require to be in the Scotch Courts."

In answer to that letter Messrs. Renshaws write on the 27th December acknowledging receipt and say: "We were aware that any proceedings against Messrs. King, Brown & Co. would have to be taken in the Scotch Courts, but we are obliged to you for kindly calling our attention to the matter."

We now come to the important letter which will alter the complexion attempted to be put on our case by Mr. Garcke, and this letter we give you in full:—

Edinburgh, 14th January, 1888.

Anglo-American Brush Company and
Messrs. King, Brown & Co.

Dear Sirs,—Referring to our correspondence in December last we are disappointed that an action has not ere now been served here against our clients.

You must be aware that your clients have threatened legal proceedings against ours repeatedly during the last three years, but have never instituted any such proceedings. Your clients are now warning the public by advertisements against using machines not made by your clients or their licensees.

These threats and advertisements have seriously injured, and are injuring, our clients; and if your clients do not within the next four days take the steps they have so frequently threatened of bringing an action against our clients, our clients will, for their own protection, commence proceedings against yours.

We are, &c.,
Davidson and Syme.

To that letter a reply, dated 19th January, was sent by Messrs. Renshaw, stating:—"The only reason for delay was the difficulty experienced in ascertaining the users of machines made by your clients resident in this country. We have now discovered the users, and a writ will be issued in the course of to-morrow, we shall thus be able to gratify your clients' desire for legal proceedings." It may here be mentioned that this applied to the lighting machinery of the Orient Company's steamer *Ormuz*, for which work the Brush Corporation were our unsuccessful competitors, and therefore there could be little difficulty experienced in discovering a user.

King, Brown & Co.

February 8th, 1888.

The Crompton-Swinburne Dynamo.

With regard to the improvements in dynamo-electric machinery devised by Messrs. Crompton and Swinburne and your editorial note on the subject, may I be allowed to point out that the dynamo armature is even more like that of a machine called the Oerlikon dynamo than it is like a Rankin Kennedy transformer. If Mr. Swinburne's eyes were as restless as you say his brain is, he must have become aware long ago of the fact that we have been manufacturing a dynamo having an armature with the wire embedded in holes of various shapes since 1885. Besides having been illustrated in nearly all the European technical journals, English, of course, included, they were shown at the Manchester Exhibition, and they are at the present time being referred to in most of your contemporaries in connection with the recent trials of the transmission of power installation I made in 1886 between Solothurn and Kriegstettin. I certainly regarded discussion as to the probable effect of embedding the armature wire in the iron, with a view to diminishing the air space as closed, now that there are numbers of machines so made working quite successfully in various parts of Europe.

C. E. L. Brown.

Oerlikon bei Zürich, *February 6th*, 1888.

The Government and Telephone Companies.

In your leading article "The Government and Telephone Companies," you mention that the subject is one of general interest. I therefore take the liberty of stating my views upon the question of the purchase of the telephone companies by the Postmaster-General.

Suppose negotiations should be entered into for this purpose, the question will arise, What have the telephone companies to sell?

Firstly. Two master patents which will expire in two or three years.

Secondly. Telephone exchanges in all the principal towns, including plant, lines, wayleaves, and probably goodwill of same; also some long trunk lines between towns.

Thirdly. Concessions given by the Postmaster-General, which have to run for about 30 years, but as the concessions are not exclusive, I take it their value, especially to him who has granted them, cannot be very great.

Fourthly. Commercial goodwill. The telephone companies have not fostered the establishment of a trade, either manufacturing or commercial, in the United Kingdom; on the contrary, their policy has been decidedly in the opposite direction, and such a good-will therefore can hardly exist.

Fifthly. The chance of the Bell-Edison patents being renewed. Mr. Moseley tells us that the Telephone Companies indulge in some hope that their rights will be renewed. If they should apply for renewal, it is very certain that they will encounter determined resistance from the public, to whom they have shown few favours, and from the electrical trade, whom they have treated in a spirit of unaccountable short-sightedness, which will be apparent to them whenever the time comes.

It appears to me, therefore, that the Telephone Companies have to offer nothing but patent rights for a very short period and the plant, &c., of their exchanges.

Now, the capital of all the companies (taken from a book edited by Mr. FitzGerald) is about two and-a-half millions sterling, the market value being (quoting the same author) five millions sterling. Sir, do you think the Government, that is the public, can be induced to give that sum for what the companies have to offer?

I think the subject is one of paramount importance to the electrical trade, and I hope that when it will reach the stage of practical politics, you will lend your powerful aid to obtain a thorough discussion, and then with your permission I will again address you.

Justice.

February 8th, 1888.

[We willingly insert this letter, and we think with our correspondent that it is not at all likely that the sum named will be forthcoming for the purpose.—EDS. ELEC. REV.]

Correction for Length of Needle of Tangent Galvanometer.

Mr. Moon has taken the force between an element of current and an excentric and axially displaced pole to be simply proportional to the inverse square of the distance and to be directed along the axis of the coil. To get at the complete solution directly, Ampère's law as regards magnitude ($\delta f = \mathrm{C}\, m \sin \epsilon\, \delta s / r^2$) and as regards direction must be applied in its entirety. Mr. Moon has, no doubt, thought that his assumptions sufficiently express the facts for his purpose; but it does not appear that the result is quite satisfactory. One may (following Maxwell) arrive at the desired correction factor thus:—The magnetic potential, ω, at the extremity of a radius vector, r, drawn from a point on the axis of a single-turn circular coil subtending at that point as origin the semi-angle, α, may be expressed, when $r < c$ the distance from the origin to the circumference of the coil, by the spherical harmonic series (Maxwell, Vol. II., p. 305. 2nd. Ed.).

$$\omega = -2\pi \left\{ 1 - \cos\alpha + \&c. + \frac{\sin^2 \alpha}{i} \left(\frac{r}{c}\right)^i \mathrm{P}_i'(\alpha)\, \mathrm{P}(\theta) + \&c. \right\}$$

where θ is the angle which the radius vector, r, makes with the axis of the coil. If R is put for the radius of the coil, then when the origin is at the centre of the coil (omitting terms after that corresponding to $i = 3$)

$$\omega = -2\pi \left\{ 1 + \frac{r}{\mathrm{R}} \cos\theta - \tfrac{1}{4} \left(\frac{r}{\mathrm{R}}\right)^3 (5 \cos^3 \theta - 3 \cos\theta) \right\}$$

For unit pole at the extremity of r and unit current the moment of the force about the axis of rotation of the needle is

$$\frac{d\omega}{d\theta} = 2\pi \left\{ \frac{r}{\mathrm{R}} \sin\theta - \tfrac{1}{4} \left(\frac{r}{\mathrm{R}}\right)^3 (15 \cos^2 \theta \sin\theta - 3 \sin\theta) \right\}$$

or putting for θ its complement the angle of deflection,

$$\frac{d\omega}{d\theta} = 2\pi \frac{r}{\mathrm{R}} \cos\theta \left\{ 1 - \tfrac{1}{4} \left(\frac{r}{\mathrm{R}}\right)^2 (15 \sin^2 \theta - 3) \right\}$$

For two elementary poles each of numerical strength, m, the couple due to the currents, C, for one turn of radius, R, is

$$2 \frac{d\omega}{d\theta} \mathrm{C}\, m = 4 \pi \mathrm{C}\, m \frac{r}{\mathrm{R}} \cos\theta \left\{ 1 - \tfrac{3}{4} \left(\frac{r}{\mathrm{R}}\right)^2 (5 \sin^2 \theta - 1) \right\}$$

Equating this to the earth's couple

$$= 2\, r\, m\, \mathrm{H} \sin\theta$$

there results

$$\mathrm{H} \tan\theta = \frac{2 \pi \mathrm{C}}{\mathrm{R}} \left\{ 1 - \tfrac{3}{4} \left(\frac{r}{\mathrm{R}}\right)^2 (5 \sin^2 \theta - 1) \right\}$$

Hence to the same degree of approximation

$$\mathrm{C} = \frac{\mathrm{R\, H} \tan\theta}{2\pi} \left\{ 1 + \tfrac{3}{4} \left(\frac{r}{\mathrm{R}}\right)^2 (5 \sin^2 \theta - 1) \right\}$$

The correcting factor wanting unity is therefore negative for small angles and positive for large, vanishing, as is well known, for an angle of about 26½°. A similar but usually less important correction is applicable for the width and depth of the coil. Among elementary works the subject is touched upon in Balfour Stewart and Haldane Gee, Vol. II.

Mr. Moon's correction factor may be written

$$\sqrt{\left\{ 1 + \left(\frac{r}{\mathrm{R}}\right)^2 \right\}^2 - 4 \left(\frac{r}{\mathrm{R}}\right)^2 \cos^2\theta}$$

$$= \sqrt{1 + 2 \left(\frac{r}{\mathrm{R}}\right)^2 (1 - 2 \cos^2 \theta)} \qquad \text{nearly}$$

$$= 1 + \left(\frac{r}{\mathrm{R}}\right)^2 (1 - 2 \cos^2 \theta) \qquad \text{nearly}$$

This factor wanting unity vanishes for an angle of about 45°. For $\theta = 0$ it has the value $- r^2/\mathrm{R}^2$; for the same value of θ the corresponding value in Maxwell's factor is $- 3\, r^2/4\, \mathrm{R}^2$; and the respective values for $\theta = 90°$ are r^2/R^2 and $3\, r^2/\mathrm{R}^2$.

For practical testing the correction is of no manner of importance, but it is useful as a guide in designing instruments and estimating limits of error.

A. C. Elliott.

February 6th, 1888.

Telephone Lines and Public Highways.

I should be much obliged if you, or any of your readers, would briefly inform me, through the medium of your valuable paper, whether people having residences along the side of a public road can legally object to the erection of telephone wires on poles along the road side, the local road board having given permission for the wire to be put up, and the poles being placed on the road side of the fence.

I presume that this is more or less of a legal question, but it affects electricians considerably.

Eno. H. Pelet.

[Unless the wires or poles constitute an obstruction, or are obviously dangerous to the public, we do not imagine that any legal objection could be urged to telephone lines run as described by our correspondent. Perhaps some reader possessing definite legal knowledge upon the subject can give a more positive answer. EDS. ELEC. REV.]

Galvanic Belt Frauds.

I trust that details of your excellent report which appeared in your issue of January 27th on the above subject will find its way into most of the respectable papers. In addition to this, I take the liberty to propose that a pamphlet containing the report and correspondence which appeared in the columns of your journal, be printed and widely circulated in order to cripple, if not kill, the nefarious practice at present existing amongst some of these so-called medical electricians. I shall be most willing to contribute my mite, and shall be most happy to hear from any of your readers who coincides with my proposition.

J. Jerritt, A.S.T.E.

February 6th, 1888.

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